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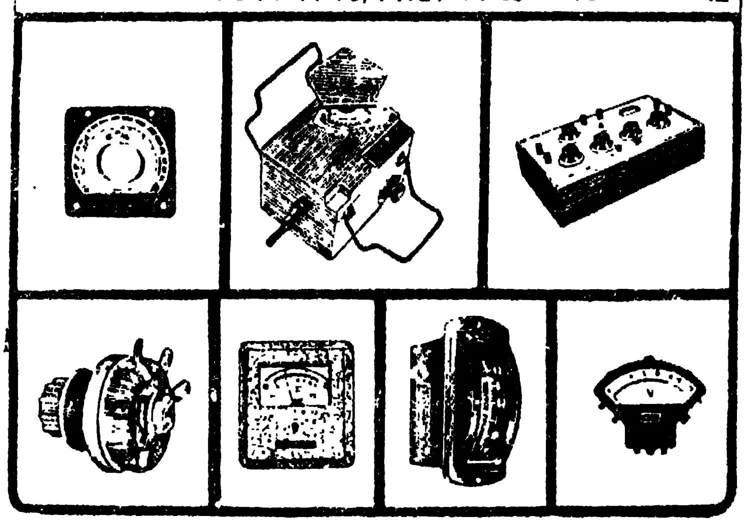

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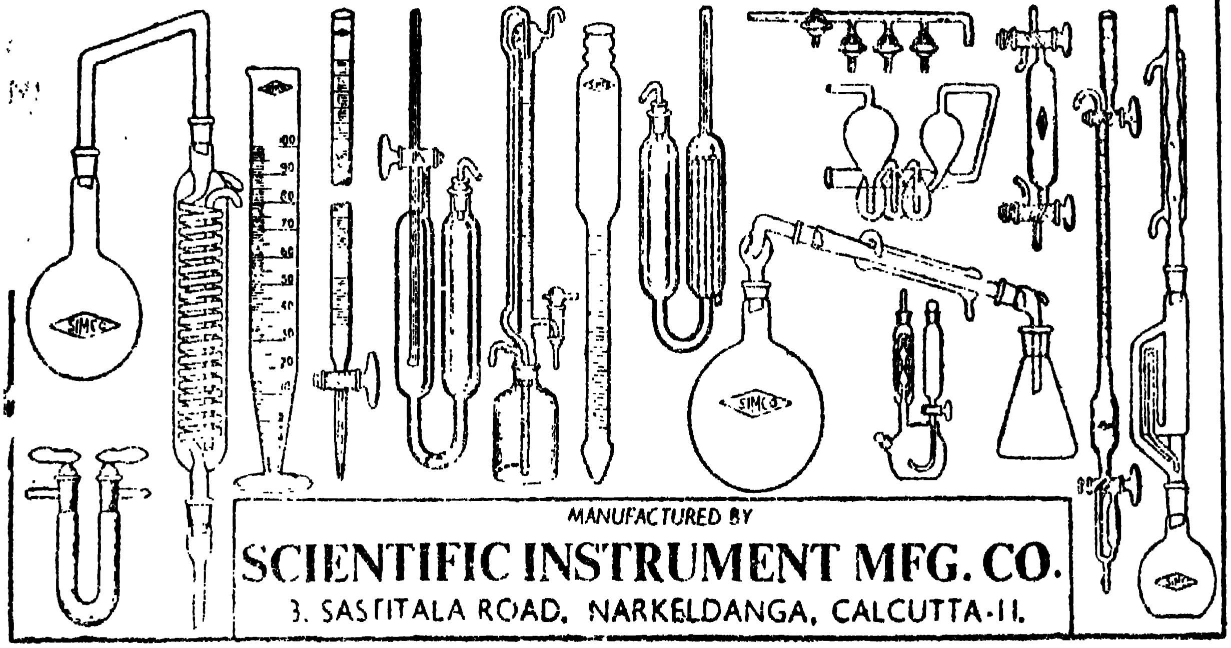

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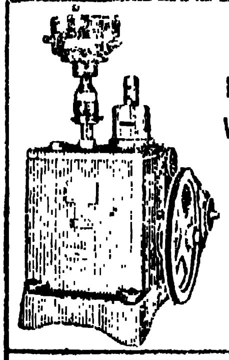

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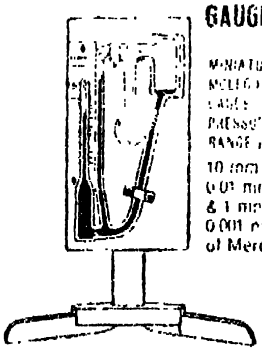

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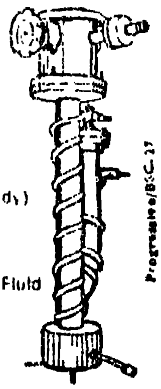

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SCIENCE & CULTURE

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QUALITY RESEARCH IN INDIA

BASIC research depends heavily on the thinking of the finest minds and used to be the exclusive domain of the universities. But since the second world war the trend has changed the world over and independent institutes away from teaching centres have become the order of the day. This became necessary because the results of some researches had much to do with the security and defence of the country, which imposed restrictions and forced to open government laboratories. Similarly the spin-offs from some of the discoveries were so great that big industrial houses started their own research and development laboratories with quite a few restrictions about transmission of results. However, it should not be forgotten that all these developments were due to the intensive research carried out in university laboratories during the approximate period 1880 to 1940. At this time, it also became apparent that for further research in any field it was necessary to have team work and cooperation from scientists and technicians from other disciplines. As the universities were rigidly compartmentalised the need for these new institutes was absolutely necessary. However, in the advanced countries the universities, adjusted themselves to the changed situation rather quickly and without hampering the training of the young minds in the universities, contributed greatly in the fore fronts of science.

The objective of university education as handed down are to develop in young minds a capacity to grasp quickly the essentials of what is presented or written, to assess quickly and at the same time critically the facts and situations, and to think in depth. With this it becomes natural for the urge to rise to extend the boundaries of human knowledge. Thus it becomes necessary that universities have academic freedom, autonomy and no secrecy in the sense that work done at one place is known in detail elsewhere.

Today in India we have over 900 research institutes all over the country with about 2.5 million scientists and technicians working in these places, the number which constitute the third largest pool of scientific and technical man power in the world. Our annual budget for these laboratories is slightly over Rs. 700 crores. The universities receive barely 4 per cent of the country's research allocations. With this meagre amount the 123 UGC (University Grants Commission) aided universities with their (about 750) post-graduate colleges support more than 16,000 research projects and turn out some 3,000 Ph. Ds every year in science, engineering, medicine and agriculture.

However, the scientific output of these institutes is not commensurate with the expenditure and much is lacking in excellence. There is no need to probe deep into this malaise. If one scans the annual reports of many of these institutes, it is clear that much of the work done in these places is as good as it could have been in the university laboratory. At the latter place it could have received greater care and dedication, a work done with great love, not a mere job completed. In our enthusiasm to advance and modernise we followed the western countries regarding research laboratories. If one visits any of these modern laboratories one can see a lot of the most modern expensive imported equipments but used sparingly. Some have even become unoperative because of lack of use. These are show pieces of our advancements and there is no dearth of visitors to these laboratories. It is also one of the complaints of our scientists that they do not get time to work on the instrument.

When our planners proposed the research laboratories away and out of touch with the universities, they reduced the research and related activities for the manufacture of knowledge for certain needs of society. But in the process they have almost wiped out research from the university. The new institutes have imbibed some of the characteristics enjoyed by the university and used them to advantage. One such is the autonomy which has degenerated in some of the institutes to autocracy. In certain places even the freedom of expression in scientific matters is curtailed. Seeing the state of affairs of research in India today, it seems that we were a bit over zealous about our research requirements, and this we did at the cost of university education and training.

In late 1950s when Russians succeeded in putting a sputnik in space ahead of the Americans, the US authorities did not rush to their national laboratories. The first thing they did was to revamp the science curricula in the schools. Today an American child picks up the rudiments of basic knowledge about nuclear and space science in the school and handles small computers. Technology war is won or lost only in the classrooms and laboratories of schools and colleges. Imported technological know-how may give some sense of advancement but unless a basis is nurtured in the country for the creation of the know-how, it will be very difficult to survive as a nation in the coming century.

It is still not too late to have a fresh look in the research facilities of the university laboratories and strengthen them sufficiently to back the existing national or autonomous laboratories. Though many of the national laboratories came into existence with specific goal or application, but it was not possible to achieve it fully because the backing basic research was lacking. Adopting certain blue prints from advanced countries and manufacturing a few proto-type equipments does not make indegenisation. It can be sustained, only if basic research is conducted and suitable modifications are introduced at appropriate stages. Universities can play a major role in this direction. At the same time, the large independent institutes can plan bigger research projects leaving the smaller projects, both from manpower and finance point of view, to the universities. It may be preferable if some of the institutes open up their facilities to the university departments in the region and even have collaborative programme. Members of the institute should also devote part of the time for improving the standards of teaching in the country.

It was heard from some of the noted scientists of the country at the science congress held at Tirupati, about the condition of science in the country, such as—our universities have become "slums of science", "science in India is third rate and we use fourth rate technology". It is good to recognise problems but we must solve them ourselves. There may be many mistakes already committed and we may be living in a make believe world that we are in the forefront of scientific research. Let us take a real scientific attitude about the whole affair. This can not be imposed by government or government sponsored laboratories alone.

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In the applied research laboratories it is necessary to recognise the thrust area and then proceed for basic research in that direction. Many of our adult industrialists feel that had we given enough attention to our traditional manufacturing items such as cotton textiles, sugar, edible oil, jute, and tea instead of sophisticated industries we could have ruled the world markets. By allowing to slip this opportunity we are purchasing the know-how in these fields too. Even now it may be possible to give emphasis where we can excel.

Let us give our universities their proper place in the field of research, let the school and university curricula be revised to meet the needs of the coming years, let the facilities, where ever they are, be shared and fully utilised. Since we have so many research laboratories in the country, the attempts should be to make them centres of excellence in the real sense so that foreigner may come, work with us in these laboratories, thus benefitting more of our people instead of one or two of us going to foreign laboratories, working there, publishing a couple of papers and returning. This will bring back the academic atmosphere and the scientific temper which has become a rare commodity. Science recognises only merit and efficiency. Hence universities should also change their attitude, which at present is quantity biased, to quality biased. Quality research in basic sciences is the key to prosperity in the coming century. ☐

B. B. Baliga

OPTIMUM DEPLOYMENT OF RESOURCES FOR RESEARCH AND DEVELOPMENT IN SCIENCE AND TECHNOLOGY

P. K. BOSE*

THE important role of Science and Technology as an instrument of Social and Economic change was fully recognised by the Government of India. During the last thirty years or so 119 Universities, affiliating about 4650 colleges, 5 institutes of technology, 150 engineering colleges and about 100 medical colleges and 350 polytechnics have been established. Every year 1,50,000 qualified scientific and technical staff are produced.

The total stock of economically active scientific and technical manpower in the country has increased from 1.88 lakhs in 1950 to 19.35 lakhs in 1978 and is expected to be 24.65 lakhs in 1983. The overall growth rate of stock is 8 per cent.

About 130 specialised research laboratories and institutes have been established under the aegis of ICAR, CSIR, ICMR, DRDO, DAE and Space and the Department of Science and Technology. In recent years public and private sector organisations and undertakings assisted by fiscal incentives have established over 600 inhouse research and development laboratories largely to meet their technological requirements. The total expenditure on science and technology is now close to 0.6 per cent of the Gross National Product (GNP). Dispite proven failures, the case for research persists for the 'frontier areas' of science which claim the bulk of meagre resources allotted to R and D and which are in any case not enough even to scratch the surface of many important areas. Even to-day 75% of the urban and 98% of rural freight moves by bullock cart. More than 90% of all urban transport in India is non-mechanised. About 50% of energy comes from primitive non-commercial sources.

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*President, Indian Science News Association, Calcutta

In the last two decades or so the developed countries together have invested at least 10,000 times the money that we have spent on R and D activity to bring about parallel and integrated development in various sectors. Such colossal gaps can not be bridged by sudden quixotic leaps into the 'frontier areas' like space and nuclear sciences.

Our basic industries of cotton, textiles, cement, sugar, jute, and even engineering goods have recently asked for Rs. 3682 crores from the Government to be able to buy urgently needed machinery—much of it from abroad—to modernise outdated plants.

To acquire effective technological capabilities in any area of production, three things are required—a large market, mammoth production, units and a determined but selective R and D effort heavily funded by the Government and the industrial units. It is being increasingly realised that India lacks all three.

Most of the advanced countries are conscious that the technology war is won or lost in the classrooms and laboratories of their schools and colleges. Universities also make a direct contribution to industrial research funded by the Governments and Industries. In India universities receive bearly 4% of the country's research allocations. With this meagre amount the 119 UGC aided universities with their 750 postgraduate colleges support 16,000 research projects and turn out 3,000 Ph. D. every year in Science, Medicine, Engineering and Agriculture.

Salarywise the researcher whether in the University or in one of the major research organisations is more or less a condemned person. A recent study by the Department of Science and Technology shows that 95% of the 15,000 scientists working in R and D organisations of the central and State Governments end their careers at retirement below the salary of Rs. 1,600 per month. More than a third of them were in the scale Rs. 425-700 scale. Only 1% were drawing above Rs. 2,000 per month. These studies also show that although the universities enrol every year more than half a million students in their science courses and half of that number in the engineering, agriculture and medical faculties, the total number of post graduate scientists in all research organisations in the country is barely 2,200. Against this according to Indians abroad register maintained by CSIR on a voluntary basis, 11,000 Indian scientific and technical personnel were working in foreign countries on many times higher salaries.

According to a United Nations survey India has only 2.4% of the World's Science and Technology manpower. The USA has 22.5%, West Germany 17%, France 14.5% and the Soviet Union 5.5%. The figure for Japan, the Worlds' third largest industrial power is also 2.4%. But evidently that country is able to derive far greater results from an identical number of research scientists and engineers than we can. Apart from the phenomenal individual dedication of the Japanese to his duty, some other factors are cited for this achievement In most of the countries scientists work in team where as in India, research and development have tended to replicate government structures. The top layer is invariably a one-man layer. Each sub-system under it has the same. Structure and there is no horizontal flow of information between the subsystems. The existing method of promotion and evaluation is still primitive.

The Science and Technology chapter of the Sixth Plan presents a list of 'indicative areas' of thrust, covering 31 major fields which in turn have been split under 160 subheads with provision for further additions. India's expenditure on R and D and related S and T activities in 1980-81 was about Rs. 743 crores. The figures for 1981-82 and 1982-83 are expected to be of the order Rs. 860 and Rs. 990 crores respectively. In 1980-81, an expenditure of Rs. 194 crores was incurred by the inhouse R and D units of the public sector and private sector industries and the rest of Rs. 549 crores was accounted for by units not engaged in production. Approximately 0.66% of GNP was spent on S and T activities during 1980-81, 86% of the total expenditure was incurred out of Govt. funds and the rest was financed by the private sector. About 1.84 lakhs personnel were employed in R and D organisation out of which 0.62 lakhs were directly engaged in R and D activities.

In any plan 'thrust' areas are those to which the country has committed its largest investments. Going by the yardstick of national objectives, it should not be difficult for India to identify five 'thrust' areas in which research should be carried out on a massive scale and linked directly to production lines.

The first of these without question would be agriculture. The high yielding varieties technology in India is still somewhat rudimentary and it is applicable to only a few pockets. New varieties and total packages of practices have yet to be developed for the 'dry' and 'very wet' areas which constitute the bulk of our 140 million hectare cultivated area. It is desirable that the thrust in agriculture should be in these areas and not in the new 'frontier areas' such as bio-technology in which our interest will have to academic for quite for sometime.

Soil technology is usually neglected. The committee on Environment Planning has been capaigning for years to reclaim at least half the country's 180 million hectare waste lands and save the 6,000 million ton of fertile soil that flows into the sea every year. A large number of technology packages are needed to achieve these adjectives.

Capacity utilization of large number of major irrigation projects in the country ranges from 33 to 50 per cent. The efficiency of water use and pumping systems in the 7.5 million dug wells and 1.5 million tubewells is extremely low. About 25 major dams have breached or collapsed with disastrous consequences in the last 30 years. Inspite of these facts the allocation for irrigation research is too meagre. Only 4 crores a year is provided for R and D. Adequate investments in artificial and bio-pesticides could wipe out all the oil seeds deficiency which costs us several hundred crores of rupees every year in foreign exchange. Cotton, Soybeans, plantation crops and a number of other items need urgent technological up-gradation through research.

Next to agriculture population control is the most important thrust area for Indian Science. China and Japan have already brought their population growth rate down to almost 1% but we have been unable to bring it down below 2.4%. Although some researches are underway into the new methods of fertility control but still a great deal of interdisciplinary team work with considerable investment needs to be done to develop full socio-medical contraceptive packages for variegated conditions.

Third priority is conventional electric power. In the plan document Rs. 25,000 crores have been allocated for the extension work but only Rs. 10 crores a year on its R and D. If our meagre forest resources are to be saved from denudation at the rate of 1 million hectares a year or more, strong linkages will have to be established with rural energy and the distinction between commercial a non-commercial resources.

Electronics research, for which only Rs. 7 crores a year is provided is another major area which India can not ignore. The entire areas of instrumentation, communication, aviation and space have gone electronic, rendering all past technologies obsolete. Electronics offers the only cheap and effective means of reaching education, information and entertainment to the masses.

The country needs to a dopt as the fifth thrust area the technology of 'operations, maintenance and standardisation'. At present there is no R and D allocation on this head. Different surveys have established that at any given time only 33% of the country's industrial capacity is functioning and the rest is idle largely due to operational failures and the absence of maintenance systems.

Thus one can unhesitatingly recommend agriculture, population control, power, electronics and operations as the major five thrust areas for Indian technology for which substantial additional resources should be provided to maximise output and employment. □

BASIC RESEARCH IN INDIA*

S. C. DUTTA ROY†

In the tussel about the need for applied research, and research of national relevance the importance of basic research is often being under estimated. A case is made for a balanced approach and a critical assessment of all research proposals—basic or applied, so as to guard against the misuse of research funds for routine development or repetitive work. Similarly, a critical evaluation of the end product of a research project is called for, to assess the actual results obtained and their significance in relation to the original aims of the project. Finally, the need for basic research in industry, and for a strong collaboration between academic, industrial and Government institutions is emphasized.

Basic Versus Applied Research

Of late, much is being talked about so-called applied research and relevance of research to national needs; and often, research fund administrators are happy if a research ends up in a piece of equipment which performs some job, however ineffectively it may be, as compared to what has already existed in the developed countries, may be since a decade ago. Such administrators find it fashionable to club all basic research as 'academic' and therefore useless persuits. This, in my opinion, is a dangerous trend; and if allowed to persist, will keep India continually lagging behind, more and more, in the state-of-the-art in science and technology in the developed countries. It is an elementary fact, although frequently ignored, that behind a technological development, there goes a lot of basic research, carried out over many many years.

It is also a fashionable thing in India to talk about the recovery of Japan from almost ground state after the second World War to one of the foremost industrially developed nations, and that India should follow the suit by persuing applied, rather than basic research. This, I think, is based on a rather superficial view of things. The initial recovery rate of Japan was not at all impressive, and the enhanced rate was not solely due to emphasis on applied research, but to a number of other factors, including political and trade interests of other nations. After achieving a somewhat comfortable position, Japan has undertaken extensive basic research and if today, anybody claims that basic research in Japan is at a lower key as compared to some of the Western countries, he will simply be not stating a fact Japanese contributions to science and technology are so important today that a number of publishing houses in the West are translating Japanese journals, sometimes cover-to-cover for circulation in the English speaking world. Although the subscription rate for each of these journals is at least four times that of a comparable American journal, these publishers are doing booming business. This only demonstrates the high quality of basic research Japan is carrying out.

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*Based on a lecture organized by the Delhi Science Forum and Delivered at the INSA Auditorium, New Delhi.

†Professor of Electrical Engineering, Indian Institute of Technology, New Delhi 110 016.

The point I wish to emphasize is that for India, there is no 'quickie' or short cut for reducing the scientific and technological gap with other advanced countries. What we can do perhaps is to start from what is available in the open literature and continue basic as well as applied research side by side. Any undue emphasis on either is likely to lead to undesirable results. A balanced approach is necessary ; what is the optimum is perhaps difficult to determine, but if the research agencies keep an open mind towards both basic and applied research, and if they, after a very careful assessment of the soundness of a research proposal, support it, irrespective of whether it is of basic or applied nature, we shall be making a good start.

Basic Research Should Have a Motivation

While I strongly advocate the cause of basic research. I am also aware that the large volume of so-called basic research in India as well as in some other parts of the globe is unmotivated, repetitive and routine. Any basic research must have a link with the real world i.e. it must have a motivation for potential use. By use, I don't necessarily mean practical utility ; use could, for example, be in explaining a certain observed phenomenon. A good theory to explain the peculiarities of jump phenomenon in some practical nonlinear circuits is basic research. But someone trying to interconnect nonlinear devices in various ways and to analyze them for possible jump phenomenon is doing unmotivated work. Not that such efforts may not lead to something useful but the result to effort ratio is likely to be infinitesimally small, and above all, this is far from being a scientific method. As another illustration, suppose a worker measures the dimensions of dew drops, in-situ, to an unbelievable accuracy ; naturally, he needs a lot of refinement and innovations in the measuring equipments. 'So what ?' One asks. If this measurement is not relevant in some context, what use is it and why should it be called research ?

Repetitive research is a common phenomenon in many well established research groups in universities and other organizations. This, too, is a manifestation of unmotivated research. Some Professor, working with his students, establishes a facility for some sophisticated measurements on some specific materials of practical importance, with generous grants from one or more agencies. After the initial aim is fulfilled, the facility continues to be used for generations for measurements on all kinds of variations of the basic material, resulting in a large number of Ph. D. theses, and a much larger number of research papers. The later work is routine and does not involve much of thinking or innovations—it just requires hard labour. Spectroscopy, for example, enjoyed this state of affairs for a long time in India.

Applied Research Should Have a Basic Component

In the field of applied research also the situation is confusing and hence exploited for misuse of funds. In popular terms, applied research seems to convey the idea of an effort which should culminate in a piece of useful equipment or a gadget. Some people also appear to identify any experimental work as applied research. In the name of applied research, there are many groups who copy a standard design of an equipment, with some indigenization, and make tall claims of saving India's valuable foreign exchange. Equipment design and development, unless it has an innovative component, is not research.

Applied research, to my mind, is that effort which aims at applying results of basic research to a certain practical problem. In fact, the line of demarkation between basic and applied research sometimes is very thin. A good research has to do a combination of both. Basic research, unless it can be applied, tends to be unmotivated, while applied research, without a basic component in it, tends to boil down to copying a standard design. Suppose one comes out with a new design of a solar cooker, which is significantly more efficient than available designs and yet less costly. In the process, the designer has to solve the problem of more efficient energy collection, and less heat losses, by some innovative technique. He has to understand heat transfer phenomenon well and to apply the available results to be able to arrive at an optimum design in a scientific manner. I would call this a piece of good applied research ; if standard basic research results are not available to the configuration he has invented upon, he might have to handle the heat transfer problem afresh. Thus he has to do a bit of basic research himself.

Assessment of Proposals and Evaluation of Achievements

Being associated with some sponsored research projects, I have some direct experiences of how research projects are evaluated. Many pieces of indirect information about evaluation have also come to my knowledge from friends in other organizations. The usual experience is that except one or two, majority of the members of the evaluation committee do not have more than a casual acquaintance with the subject area of the project. As a result, they get stuck on minor points and trivialities and the major achievements are not appreciated. The attitude of those members who are slightly more knowledgable sometimes leaves much to be desired. Many evaluators have the only objective of finding fault, wherever they can, with the project, and if they cannot do so, end up in making wild suggestion as to how the project should proceed in the future. Sometimes, this is in wide variance with the original aims of the project. Worse still, the team which evaluates the project later may have a different composition and the drama is then repeated.

The story on research project proposal assessment is no better. It is usually done by one or more referees. In principle, this is in order, but in the Indian context, the assessment is often influenced by personal bias of the assessor towards the proposer or his research. Since the number of active researchers in a given field is not too many, often the funding agencies call upon the expertise of once-active-now-passive type of referees. Many of them are outdated because they are not conversant with modern developments and therefore try to impose their own outdated ideas. The situation is worse if the proposer and the assessor are both active workers and belong to two different 'mutual support' societies. Yes, such societies do exist, although unregistered and vehemently denied in public, in which the members support each other's proposal following the 'live and let live' principle.

I strongly recommend that the research funding organizations like the UGC, DST, DOE etc. should get together and evolve a mechanism for more objective assessment of research proposals and evaluation of completed research projects. It should be ensured that the members of such committees are well reputed scientists, whose credentials are beyond question. If necessary, we should seek the opinion of well known experts from outside the country. There is, I believe, no dearth of funds, as far as scientific research is concerned ; it is only the problem of a proper utilisation that India has to solve.

Basic Research in Industry

Many of the fundamental scientific results of importance have emerged from industrial research laboratories in the West. An example in point is the transistor, which has revolutionized the whole field of electronics. This device was born through the team effort of a group of scientists bearing loyalty to various diverse disciplines like physics, electrical engineering and metallurgy at the Bell Labs, USA. The most recent solid state device, viz. the charge coupled device, also originated at the Bell Labs in 1970, while its elder sister viz. the bucket brigade device was conceived a couple of years earlier at the Philips Research Labs, in the Netherlands. While these are examples of discoveries which are of direct interest to the concerned industry, there is a lot of theoretical and fundamental research which is carried out in the Western industrial laboratories. Filter theory and design, for example, was developed to great academic depths and much beyond practical utility at that time, at Siemens Co. in Germany; Marconi Co. in U. K. and Hughes Aircraft Co. in the United States. I met a pure mathematician at the Post office Research Centre, Dollis Hill, London, who was deeply involved in the problem of sensitivity in networks. This investigation was not foreseen to be of any use to the British Post Office directly in the near future. I know a few very smart network theorists in the MBLE research labs of Philips at Belgium who have made outstanding contributions in network theory.

Research laboratories in Indian Industries are virtually unknown. What exists in a handful of industries can be more appropriately called problem solving set-ups, geared to the specific problems arising in those industries. The picture is very dismal, particularly in the case of Electronics industries. There is some enthusiasm, in the recent past, in public sector electronics industries in India; to set up development teams for prototype products, which are in routine production in advanced countries. In the private sector, the emphasis appears to be more on copying, and hence quick returns in terms of money. Because of lack of sufficient competition and hence quality control, anything useful made is sold. There is therefore no incentive for industries to spend money on the so-called basic research, which most industries consider as 'academic' and therefore 'worthless'.

The textile industries, I am told, are an exception and I am glad it is so. Perhaps we should take a lesson from them, and start a few basic research organizations, soly funded and managed by the industries in every subject of technological importance.

The collaboration between academics and industry has not materialised, even though we talk a lot about it, mainly because of the lack of a research component in the industries. What is the incentive of a professor in a University to spend some time in a production factory ? Similarly, what can a senior engineer in a production factory contribute to an academic environment ? The exchange between academics and industry would be meaningful only when the two sides can converse on some common wavelength and this link, I strongly believe, is research and that too, basic rather than applied research.

Concluding Comments

Despite the dismal picture I have portrayed about scientific research in general and basic research in particular in India. I am quite optimistic that if appropriate corrective steps are taken, the picture will gradually change to a brighter one. Even creating an awareness that all is not well with basic research in the country will be a positive contribution in this direction. The scientific community has a great role to play in this task, mainly in the form of self disciplining, in order to avoid falling into the kinds of traps I have discussed, which will lead to avoiding wastage of national resources. With such scientific culture, yet to develop in India, and with the gradual permeation of basic research in industry, I am sure things would gradually improve. I conclude with this hopeful note.

My sincere thanks to the Delhi Science Forum for giving me an opportunity to share my thoughts. □

ROLE AND STATUS OF R & D IN INDUSTRIES IN INDIA-TODAY AND TOMORROW*

S. K. GUHA**

THE prosperity of a nation depends on the industrial growth in the country and, therefore, GNP (Gross National Product) is used as a criterion for measurable economic condition of a country in the international community. Along with GNP the country's balance of payments, which depends on the export/import ratio, is also equally important in respect of the country's economic progress. India being a developing country is obviously in the lower rank in the world GNP table.

However, since India gained her independence in 1947 she has made considerable strides in the industrial development, both heavy and light, during the successive Five Year Plans. Today, India can boast of diverse types of industry, e.g. large-scale manufacturing units in the public and private sectors, medium and small-scale industries. The structure of these industries is rather complex in character because some are entirely Indian owned (big or small), some are subsidiaries (with mixed equity shares) of some multinational giant firms, some are joint foreign collaboration firms, some Indian firms are using foreign technology under licence agreements but no foreign capital, and the rest are operating with their own technical 'know-how' either copied from the already available product in the market within or outside the country or developed by their own technically skilled persons independently or with assistance from some research organisation in India. Whatever may be the situation, modern industries in India today are by and large science/technology based. Consequently, the question of R & D activities has to be considered to a large or small extent by all the Indian industries, especially, because of the competitive market today.

In any modern industry the total financial investment is divided between personnel, materials, machine/equipment for production as well as quality assessment. The ultimate object of the industry is profit-making through increasing sales of the products at competition prices. In achieving this objective design and development of new products, modifications, and improvements in the existing products in meeting the changing market demands have to be backed by considerable R & D efforts. Historically, France was the first country in the world to apply scientific methods to industry in the late 18th century followed by Germany, the USA and the UK later. The effectiveness of the applications of science to industry was well recognised and, therefore, a definite R & D policy was adopted by the large firms in the advanced countries even early in this century. For example, during the solar eclipse mission to Sweden in June 1929 the late Prof. M. N. Saha, FRS, took the opportunity of visiting Philips Lamp Factory in Eindhoven, Netherlands. After visiting their Research Laboratory (founded in 1914) attached to the factory, with a staff of 25 well qualified scientists, Prof. Saha[1] asked the then Director Dr. Ooster Huis : "Is the factory getting any return for the huge sum spent only on scientific research in your laboratory ?" In reply, Dr. Huis said : "We are not only making profit after meeting the necessary expenses but also helping the growth and development of the factory through the discoveries made by our scientists in order to fight competition from similar factories in England, Germany and the USA".

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*The contents in this article represent the author's own views, and the Company is not involved in this matter in any way.

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Today the role of R & D in industry is well recognised all over the world, including India. There is already a list of R & D laboratories, including some industries in India, recognised by the Department of Science & Technology, Government of India,

In discussing the allocation of resources for R & D in industries in India it would be appropriate to consider industrial research in a wider sence, covering the National Laboratories and some existing co-operative research organisations in India. Total R & D effort which is also closely tied up with 'technology transfer' may take many forms, for example, Fundamental Research, Applied Research, Design and Development—these are the stages required for the production and sales of a new product in the market. All these stages, including production costs money while sales only bring money. Even after production is established R & D may be necessary and beneficial for trouble-shooting applications of the product as well as for improvements in design and production methods, depending on the competition in the market. These post-production stages are applicable even to the factories making old products by established methods and standard tools.

Before making an attempt to prescribe the right sort of future R & D effort for the Indian industries it is necessary to briefly describe the present conditions in this respect.

It is well-known that major industries like mining, drugs and chemicals, and textile were started by the British firms during the Imperial period. The public undertakings like Indian Railways and Calcutta Tram Company were also built by them. As the machineries and technologies were all imported or even Indian raw materials, in some cases, were processed in Britain and then re-exported to India for producing the finished goods in India, there was no necessity for R & D at all in India for a long time. But, with the growth of these industries and of some Indian industrialists coming forward in some sectors like steel (TISCO), chemical (Tata, BCPW and others) and textile (cotton, jute and silk) the concept of applying science to industry gradually gained acceptance in India in order to meet the rising demands nationally and internationally. Perhaps, textile industries (cotton and jute in particular) were the fore-runners in applying science and employing qualified scientists for the job in India—followed by chemical, tea, silk and other industries. The field of cotton research had been started out by the Cotton Textile Research Institute, Matunga, Bombay, for the industries. Later on ATIRA, Ahmedabad, a co-operative body, was established in the late forties or so. In jute too co-operative research was started on the British model at IJMARI, Calcutta, during the thirties sponsored and jointly financed by the Indian Jute Mills Association. Now it is known as IJIRA under the direct control of CSIR. In addition, there is Jute Technological Research Institute, Calcutta, under the Ministry of Agriculture, Central Government. These are both helping the jute industries in solving their problems and in developing new uses of jute and allied fibres. In this area, some companies have even their own Testing and Quality Control/Development Laboratories located inside the mills. There is also a well established laboratory owned by Tea Research Association at Tocklai. This may be considered more or less ideal as far as R & D in industry is concerned. Unfortunately, in the Eastern region there exists no research facilities in the cotton industries as revealed during the Platinum Jubilee (1983) celebrations of the Serampore Textile Institute (West Bengal) held recently. Silk and synthetic fibre industries are served by two well known research institutes—Berhampore Sericulture Institute in West Bengal and SASMIRA, Bombay. In the chemical and metallurgical field some companies have their own research laboratories. But similar research facilities (individually or co-operative) do not exist even today in certain areas, e.g. lamp industry, motor car industry and transport except, perhaps, Railways. In the field of lighting, of course, application research has been initiated by the R & D wing of some leading lighting firm which is also recognised by the Department of Science & Technology.

Since 1947 tremendous progress has been made in the field of scientific and industrial research in India through the direct support of the first Prime Minister Jawaharlal Nehru. A chain of National Laboratories, covering various fields of science, have been established and operating under the CSIR to serve the various industries throughout the country. These have been followed by some Regional Research Laboratories in order to utilise the local raw materials and the already existing local industries. But, unfortunately, inspite of all these developments no satisfactory dialogue has been established yet between these Government sponsored laboratories and the industries—both blaming each other. On the one hand, the Directors of the National Laboratories are blaming the industrialists for not adopting the majority of technologies developed by them. On the other hand, the industrialists do not appear to find it economic to buy the half-baked indigenous technologies in developing new products in their companies. As a result they are compelled to adopt foreign technologies. In this respect, I have my own experience over the last three decades both in India and in England. Having sevred both the private industries and one of the famous National Laboratories in England over nearly two decades till 1972. I witnessed (as an active participant in England) the changing projects of the National Laboratories since the days of DSIR to meet the requirements of their customers in the public as well as private sectors. In order to introduce more practical and customer oriented projects the old DSIR setup was dissolved and some of the laboratories like National Physical, National Chemical, Building Research Station (now under DOE) and some others came under the new Ministry of Technology in 1965. In this way, a much closer collaboration was effected between the National Laboratories and the industries. In this process even the learned societies like the Institute of Physics (London) and the Royal Institute of Chemistry (London) played a very important role by bringing the University and Government scientists, and the industrial R & D scientists/technologists on the same platform through their monthly sessional meetings and seminars on various topics with special emphasis on industrial applications. Unfortunately, there exists a rather solid barrier between those three catagories of scientific workers in India even today. The result is the continuing gap between science and industry here.

In view of the rather complex structure of the Indian industries, lack of proper communication and co-ordination between the National Laboratories and the universities on the one hand, and the industries on the other, lack of interest of the professional scientific societies in industries, and lastly, the large technology gap between the developed countries and the developing ones it is not so easy to suggest some uniform allocation of resources for R & D in all these industries. In the earlier days of industrial research it was thought that higher R & D expenditure should inevitably lead to higher economic growth. But, O.E.C.D. studies during the sixties have revealed that there is no direct relationship between R & D expenditure and economic growth. For example, in his 13th Fawley Foundation Lecture on "Technology, Industry and Economic Growth" (1966) the late Professor P.M.S. Blackett[3], FRS, Nobel Laureate, drew attention of his audience to the bare fact that in 1962 Britain spent 2.2 per cent of GNP on R & D compared with 1.5 per cent in France and 1.3 per cent in West Germany.

Against this background Britain's economic output per man grew between 1955 and 1964 at the rate of only 2.6 per cent per year, compared with 4.4 per cent, 4.7 per cent and 8.8 per cent for France, West Germany and Japan respectively. But, R & D expenditure of Japan was only a little over half of Britain. Of course, Britain's higher R & D expenditure included her relatively high defence expenditure.

In view of this situation it is not possible to give a single formula for investment on R & D in industries in achieving tomorrow's objectives. Considering the Indian scene allocations of resources in QSEs ('Qualified Scientists and Engineers' as coined by the late Prof. Blackett[3]), money and machine for R & D should be carefully considered in relation to the size of the factory, nature of the existing product range and the future expansion plan for increased productivity and product range. As the empirical methods of production are becoming less and less economic even the small scale industries should employ a few technical (if not QSE) persons familiar with basic engineering design and principles of basic sciences. This is necessary for the company not only to maintain the quality of the existing products but also to introduce new products through 'technology transfer' indigenously if and when the company plans for further growth. Then the medium scales industries, whether using indigenous or foreign technology under licence, should have comparatively stronger R & D centre with considerable number of QSEs to cope with the product development and modification, trouble-shooting, product applications, and lastly, changing production techniques. The QSEs should be carefully selected so that they are able to communicate with the National Laboratories and the relevant research associations in order to transfer proper technology and foresee potentialities of the results of their researches for future applications. Even today large volume of researches, pure and applied, are being carried out in the various above mentioned laboratories, autonomous research institutes and development laboratories, and the Institutes of Technology. Following the pattern of Harwell A.E.R.E. even BARC has been engaged in developing indigenous non-nuclear projects and transferring techologies to some public sector manufacturing undertakings mainly. Consequently, the question of dissemination of information has become an important problem. So the QSEs employed in the R & D group should be able to act as coordinators between those laboratories/institutes and their employers.

Lastly, the large firms of any category, as mentioned earlier, having many manufacturing units with a wide range products, can undertake R & D activities on a bigger scale, depending on their objectives and aspirations. In fact, some firms in this category have already established their own R & D centres. Essentially, even if they are using imported technology to a large extent, their R & D efforts may include the following: (a) Target research, (b) Product Design and Development, (c) Factory Engineering, (d) Trouble-shooting and (e) Application Research. In order to achieve these objectives they should employ the necessary number of QSEs backed by the appropriate number of technicians. There is no rule of thum for the number of technicians required for each QSE. But, from experience, a ratio of 1:2.5 approximately for 'QSE' to 'technician' may be sufficient.

If one takes the examples of some giant international companies like Bell Telephone, IBM, RCA, and G. E. in the USA; GEC, ICI and Shell in the U. K.; and Philips in the Netherlands one can recommend inclusion of even fundamental research in the R & D efforts of the large Indian companies. Of course, fundamental research in an industrial loboratory is rather different from that carried out in the university laboratories. According to the internationally known industrial physicist Prof. (Dr.) H. B. G. Casimir[4] (a famous student of the late Wolfgang Pauli, Nobel Laureate), Director, Philips Research Laboratories, Eindhoven (Netherlands) for a number of years till 1972, "There is Fundamental Research with very heavy capital F and capital R. I should like to define this as research dealing with entirely new phenomena connected with basically and philosophically new principles in the description of nature. It is easy to give examples: the work of Faraday and Maxwell on the electromagnetic field, the work of Boltzmann and Gibbs on the kinetic explanation of thermodynamics phenomena, Einstein theory of relativity, Bohr's quantum theory and the quantum mechanics of Heisenberg, Schrödinger and Dirac belonging clearly to this category. Next comes fundamental research with a more modest f and r. The aim is still the understanding of nature, but it is dealing with fields on which the basic principles are well understood. Work on molecular spectra, solid state physics, electromagnetic diffraction, hydrodynamics would come under this group". This is very significant as far as the fundamental scientists are concerned. There is still a place for brilliant young scientists in an industrial laboratory. For instance, the late Irving Langmuir (whose one important work at the G.E., U.S.A., led to the development of the gas-filled tungsten lamp) won the Nobel Prize. Then the names of the three joint Nobel prize winners Bardeen, Brattain and Shockley of the Bell Telephone are well-known for the development of transistor which has revolutionized the electronics industry.

In the absence of any direct relationship between R & D expenditure and economic growth it is not so easy to formulate any definite industrial research policy as far as financial investment is concerned. Thus Sir Robert Clayton (an experienced Research Director, G.E.C.), the present President of the Institute of Physics (London) remarked: "The last thing a company should do is to allocate a fixed percentage of turnover to research .... First you must ask 'Why ?' about any piece of research."[4] Perhaps, commercial management which must foot the bill out of the profits may play a dominant role in this respect.

In a developing country like India, it is evident, industries have to continue to buy foreign technology in the major sectors for years to come, if the country has to meet the basic needs of the rapidly growing population in terms of food, clothing, shelter, transport, power, light and drugs. Under the circumstances, in order to avoid the adverse effect on the balance of payments the Central Government should try to strike a balance between 'technology transfer' from the advanced countries and the 'development of indigenous technology' by encouraging the industries for R & D, and coordinating all the CSIR Laboratories (by introducing customer oriented project) with the industries in sectors requiring closer attention with the shortest possible time lag. □

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NOTES & NEWS

Portable solar cooking unit

A novel solar cooking unit has been developed by the Central Mechanical Engineering Research Institute (CMERI), Durgapur, West Bengal.

The CMERI cooker consists of a collapsible curved reflector (1 m diam) mounted on a tripod light-weight stand. The reflector concentrates sun rays in a specially designed two-chamber pot. The stand can be manoeuvred to track the sun. The total height of the unit is about 1.5 m. The components of the unit are detachable and can be kept in a small kit. Hence, the portability of the unit.

The cooker has some traits which are distinct from those of solar cookers so far developed and marketed in the country. The unit is suitable for small families for regular use as well as for occasional use as in camping. The gadget takes less than 2 hr for cooking in winter and much less in summer. The cost including those of the cooking pot and carrying case is about Rs. 400. ☐

CSIR News

Sampling gun

In any metal-melting unit, small ingots are cast from which drillings are taken as samples for chemical analysis. To get round this difficulty, the Central Scientific Instruments Organisation, Chandigarh, has designed and fabricated a sampling gun.

It is a very simple and handy device for quick extraction of the metal in the form of wire in a refractory glass tube directly from the melting pot. Such wires can then be easily cut into small pieces to be utilised as samples for subsequent analysis, thereby avoiding any risk of external contamination. Also, provision has been made in the design to adjust the quantity of the extracted sample as needed. ☐

CSIR News

Electrochemical method for guaiacol acetate

Guaiacol acetate is normally prepared by a chemical method which involves multistage synthesis and laborious purification steps, the yields being very poor. A simple electrochemical methods for its preparation has been worked out by Central Electrochemical Research Institute, Karaikudi. Anisole is oxidised at graphite anodes in a bath containing glacial acetic acid and sodium acetate. At the end of the electrolysis, the reaction mixture is steam-distilled to collect the mixture of guaiacol acetate and smaller amounts of p-acetoxyanisole (which has its application in manufacturing quinols).

Guaiacol is an organic compound used in the manufacture of vanillin, which is widely used as a flavouring agent. ☐

CSIR News

Cultivation of *Enteromorpha*

Techniques for the cultivation of an economically important green seaweed, *Enteromorpha*, have been developed by Central Salt & Marine Chemicals Research Institute, Bhavnagar.

The plants are cultivated on nets in the intertidal belt of the coast. A biomass of 920-1718 g fresh weight/m^2 area of the net was obtained in 6-8 weeks during winter. Here the plants are not provided with any fertiliser treatment. Three crops can be harvested in a year, 1 ha of the coast producing yearly 1.9 tonnes of dry alga.

The plants can be cultivated also on-land and on nylon threads maintained in artificial ponds. A biomass of 916-1226 g (or even 1775 g)/m^2 area of the pond was obtained in 5-6 weeks' growth period. In this method, the plants require proper fertiliser, light and temperature conditions. Six or seven crops can be harvested in a year, 1 ha of the pond producing yearly 8.6 tonnes of dry alga.

The *Enteromorpha* spp. are used as food. The institute has also isolated an active principle, being effective against the TB—causing organism *Mycobacterium tuberculosis.* ☐

CSIR News

International Workshop on Role of Scientific Societies and Academies in National Development

The Indian National Science Academy, in association with the ICSU Committee on Science & Technology for Developing Countries (COSTED), organised a Workshop on 'Role of Scientific Societies and Academies in National Development' on 15th & 16th November 1983 in New Delhi.

The Representatives of the federal Scientific Societies and Academies of Afghanistan, Bangladesh, China, Malaysia, Nepal, Pakistan, Singapore, Sri Lanka and Thailand participated in the Workshop. Detailed discussions were held on some of the major problems faced by the countries in this region of Asia including energy, environment, health care and population control, scientific & technical man-power & training, and resource planning. The Representatives also presented their country reports highlighting the status of science and technology in their countries, their experiences in tackling these problems as also their thoughts on cooperation on regional basis. The Indian scientists presented key-papers in each of the five areas and had extensive discussions on how the Scientific Societies and Academies can collaborate with each other to work for national and regional development.

Considering the need for the Scientific Academies to play a more positive role in national development and

Recognising the potential of collective effort in application of science and technology the delegates attending the Asian Regional Workshop on Role of Scientific Societies and Academies in National Development at New Delhi during 15-16 November 1983

Resolved—that there is an urgent need for mutual cooperation among the various Asian countries in the area of utilising Science and Technology for National Development.

To achieve this, it was unanimously agreed that it is desirable to initiate contact with all Academies and Societies in the region with a view to exploring the possibility of the formation of a Federation of Asian Federal Scientific Societies and Academies. The main activities of such a Federation will be :

(1) To promote exchange of scientific information ;

(2) To identify problems of regional interest and determine priorities ;

(3) To identify talents, form task force of individuals or institutions to tackle these problems :

(4) To organise training programme for man-power development in areas of common interest to participating countries such as environment, population control, survey and utilisation of natural resources, microprocessors and computers, biotechnology, etc. ;

(5) To evolve mechanisms for exchange of scientists to promote research in areas of mutual interest ;

(6) To organise joint workshops/seminars/symposia on topics of common interest ; and

(7) To prepare status reports and policy options on topics of regional importance with a view to providing scientific information to Governments to enable them to take appropriate decisions.

In order to achieve the objectives mentioned above, a Consultative Committee with the following membership has been formed :

[illegible] Public Library

Prof. A. K. Sharma —Chairman
Prof. Yan Dongsheng (China)
Dr. M. K. Rajakumar (Malaysia) —Vice-Chairman
Prof. Y. Nayudamma —COSTED
Prof. Ang Kok Peng (Singapore)
Prof. Kamchad Mongolkolkul (Thailand)
Prof. Paulo C. Campos (Philippines)
Dr. Karimullah (Pakistan)
Dr. Ratna S. J. B. Rana (Nepal)
Pandit Dr. N. D. Wijesekera (Sri Lanka)
Prof. M. O. Ghani (Bangladesh)
Prof. B. B. Shah D Jalal (Afghanistan)
Dr. T. N. Khoshoo (India)
Dr. S. Radhakrishna
Mr. A. K. Bose —Secretaries
(with powers to Co-opt)

The Secretariat of this Consultative Group will for the present be located at Indian National Science Academy with assistance from COSTED which will seek funding from various international agencies. □

International Workshop on Energy Conservation in Buildings

Central Building Research Institute, Roorkee (India) is organising an International Workshop on Energy Conservation in Buildings from April 2-4, 1984.

Objectives

The purpose of the workshop is to bring together researchers active in the field of building Physics, Energy Conservation and Renewable Energy Sources to discuss and disseminate information and present reasearch data on most recent developments, to review the present State-of-the-art and to identity future perspectives of research and development and to recommend measures for energy conservation in buildings as relevant to developing countries.

Themes

(1) Prediction of indoor environment in buildings by using available climatic and solar radiation/illumination data.

(2) Economically viable Technologies based on Renewable Sources of Energy for buildings and built environment.

(3) Future programmes for harnessing non-conventional energy sources for use in buildings.

(4) Engineering Applications of Innovative Solar Energy Technologies for improved building design.

(5) Different approaches to passive heating and cooling of built-in spaces.

(6) Energy Conservation strategies and programmes and their implementation in design, construction and performance of buildings.

(7) Development and manufacture of Energy Conserving building materials.

(8) Policy alternatives and economic implications of design and construction of buildings based on non-conventional energy forms and technologies.

(9) Future perspectives of research in various aspects of energy from alternative sources for design, construction and performance of buildings.

(10) Measures for energy conservation in buildings as relevant to developing countries including controls and byelaws in respect of energy conserving designs based on solar energy, daylight, and wind energy.

Those who propose to contribute to the workshop may please fill in a pre-registration form obtainable from Dr. B. K. Saxena, Organizing Secretary, (IWSOECIB), Central Building Research Institute, Roorkee (U.P.), India so as to reach him before January 10, 1984. □

Symposium on Statistical Methodology for Crop Forecasting and Crop Estimation

The history of forecasting and estimating the production of crops is as old as that of organised agriculture. Since, agriculture has all along been a major contributor to state revenue, estimation of crop output has been on administrative necessity. But, whereas in earlier times, estimates of crop output were generally made subjectively on the basis of reports of revenue officials, the complexities of modern society have necessitated the introduction and development of objective statistical methods for the purpose. An all-India symposium on the subject, sponsored by the U.G.C., was held in the Department of Statistics, Calcutta University during September 19-23, 1983. A large number of experts in the fields of statistics and agriculture from different parts of the country took part in the symposium.

In the context of measurement of the output of a crop in any geographical area like a country or a state, one must first be clear about the distinction between a forecast and an estimate. A forecast of the production of a crop is a figure which should be given ideally before the harvesting of the crop. An estimate on the other hand is a post harvest figure. Forecasts of crops are needed for budget formulation and short term planning, setting out import export policies, fixing support prices, chalking out storage and distribution programmes, seed replenishment, ensuring adequate supply of fertilizers, famine prevention etc. On the other hand, estimates of crop output are required mainly for long term planning, measurement of national income, identification of areas for research and development, evaluation of development programmes, implementation of crop insurance and similar purposes. In these days, there is enough awareness among people of the importance of crop forecasts and estimates. However, the methodological complexities and organisational difficulties which beset the problems of successful forecasting and estimation of outputs of crops, are often not fully appreciated.

The output of a crop in a given geographical area such as a district or a state broadly depends on two things the area sown with the crop (hectarage) and the yield rate (per hectare) of the crop. If the two are accurately known then by taking their product one can get the total yield of the crop in the given geographical area well in time.

For the determination of area under a crop until recently two distinct methods used to be followed in the different states. In those states where permanent reporting agencies like the village patwaris exist, generally the method was based on complete enumeration of fields by such agencies. In those states (the permanently settled ones like W. B., Kerala, Orissa) where such agencies do not exist, the practice was to follow the method of grid sampling as developed by Professor P. C. Mahalanobis. Roughly, the method consists in marking out square grids randomly located on the map of the entire geographical area under consideration and determining the area under the crop in each such grid. The hectarage figure for the entire geographical area is then found by the method of proportional parts by taking into account the part of the total area that is represented by the sampled grids. The complete enumeration method was generally believed to suffer from larger ascertainment errors. Further, since the patwaris had many other work to do, their reporting was seldom timely which resulted in large lags in the issue of the precasts and estimates. To remedy this deficiency the Central Govt. has recently introduced some schemes like the TRS (Timely Reporting Scheme) under which special care is taken so that timely and accurate reporting is made on 20% of all the villages in an area. The part reported upon is changed from year to year so that in a five yearly period all the villages in the area are covered by rotation. The grid sampling method was generally considered satisfactory so far as determination of area under a major crop like *aman* over a large geographical unit like a state was concerned. However, with the growing emphasis being put on block level planning and with many minor crops with relatively lesser hectarage gaining importance, replacement of traditional grid sampling by something more intensive comes on the cards. The centre proposed that here also the method of 20% sampling of villages should be introduced and for this a new scheme known as EARAS (Establishment of an Agency for Reporting Agricultural Statistics) was put forward for states like W. B., Kerala and Orissa. These states either have switched over or are gradually switching over to this new scheme. In W.B. at present both the systems are in vogue on a provisional basis.

For the determination of yield rates the method generally used by the different states is that based on random crop cutting experiments. In this method a number of fields growing the crop is selected randomly through a multistage process and then in each selected field cuts of the standing crop in randomly demarcated small areas are obtained. The yield rate in a geographical area is determined on the basis of weighments of the different cuts located in the area, due allowance being made for driage and similar factors. A large number of crop cutting experiments on different crops are made in each state by agencies like the State Bureau, State Departments of Agriculture, Revenue Departments etc. throughout the year.

The above system of forecasting and estimation of production of different crops pursued by the government was discussed and critically examined by different speakers in the symposium. Some speakers emphasized the need for minimizing what are known as non-sampling errors i.e. errors which arise at the ascertainment stage due to wrong reporting, non-response, omission etc. Minimization of such errors require proper training of field staff and tightening of supervision. Some other speakers emphasized the need for proper stratification to make the estimate of yield rate more dependable. Thus in determining the yield rate in a geographical unit, say, a block, one would get a more reliable figure if, instead of considering the block as a whole, one stratifies or breaks it up into an irrigated part and a non-irrigated part, parts under high yielding variety and under traditional variety and so on. However, there are various hurdles in the introduction of such intensive stratification at present, the main one being our lack of knowledge about the identity and extent of the various would be strata. Problems relating to special crops like jute or multiple harvesting crops like fruits, were discussed in detail. Another aspect emphasized was the choice of a proper estimate for determining the overall yield rate of a geographical unit. It was pointed out that use of a simple average of cut yields without regard to selection of the villages and fields for crop cutting, may lead to an inborn bias in the ultimate production figure.

Although crop cutting experiments are the most direct means of ascertaining the yield rate of a crop they are by no means the only ones. As our knowledge of the growth processes underlying different types of crops accumulates, it may be bossible to get the prospective yield rate of the crop in a region on the basis of parameters like rainfalls in different weeks in the maturing period, measurement of soil humidity at different depths or biometrical determinants like height of the plant, girth at definite height etc. Some studies performed with crops like rice, jute, groundnut, sugarcane were reported upon. The problem of setting up production functions to determine yield on the basis of inputs given, was also examined and some suggestions regarding methods for ascertainment of actual input figures as also for fitting a production function were put forward. For integrating the different approaches it was suggested that on the basis of information on ancillary characters, past crop cutting data, and additional knowledge about factors like variety (high yielding or traditional), management practice (irrigated or non-irrigated) etc., one can set up for each village in a block a projected yield rate and hence determine the projected yield for each village. Using these projected yield figures as auxiliary variables one can set up what is technically known as a 'ratio estimate' utilising the crop cutting figures for the current season. Such a practice, it was suggested, would obviate the need for intensive stratification but would at the same time incorporate all additional information into the estimate.

For the estimation of crop production of the country quite a different approach has been followed by some theoretical workers—mostly econometricians. Their idea is to fit suitable models to time series on production and related variables and use these to project the output at future times. The limitation of this method is that generally it can succeed only at the macrolevel. The practical as well as theoretical aspects of this approach were examined by a number of speakers.

Rapid developments in space science are gradually providing new tools for acquiring knowledge about the agricultural situation in a country. Remote sensing of agricultural crops is of recent introduction in India. Records obtained through remote sensing from satellites and aircrafts, coupled with available information about ground truths, help one to generate agricultural statistics pertaining to wide areas at frequent intervals. The potentiality of the method for determination of crop area in inaccessible regions was emphasized by some speakers.

In the present age real life problems have generally become so complex that most of them require a multidisciplinary approach for arriving at a solution. The present symposium illustrated this in the context of the problem of forecasting and estimation of crop production. There were interactions of various sorts—between agriculturists and statisticians, practical workers and theoreticians, government officials and academicians and the general feeling was that each group got enriched in the process. □

A plant for drawing large-size monocrystals

A new automatic plant has been designed for drawing substances—mostly optical and scintillation alkali-halide monocrystals—with a melting point up to 1,000°C and mass of tens and even hundreds of kg from a molten mass of monocrystals.

The huge plant consists of an electric furnace, an annealing furnace, a gadget for removing a grown crystal, an operational control panel, a control panel for a growing furnace and a control panel for an annealing furnace.

The method of growing used in the new plant ensures a high quality of monocrystals and can be used for drawing crystals of any size, but the crystal size depends on the furnace dimension. □

APN

Pneumatic transport for powdered materials

Pneumatic transport has been designed for handling cement, ash, coal powder, lime and other powdered/granulated materials.

The new plant can be effectively used in civil engineering, chemistry, agriculture and transportation. □

APN

Anaesthetic cotton

Cotton, developed by Kirov Institute of Textile and Light Industries, Leningrad, can anaesthetise the eye and dilate its pupil.

To imbue the fibre with special properties became possible by combining it chemically with adrenalin, which is widely used in eye treatment. But its solution easily washes away together with lachrymal fluid and, therefore, quickly loses the effect.

Dilatation of pupil with the help of unusual cotton is painless, sets in quickly, lasts long and does not cause irritation which makes it possible to widely use them, especially for children. □

APN

BOOK REVIEWS

Recent Trends in Wind Energy—Sharat K. Tewari. Publisher: Indian National Scientific Documentation Centre, New Delhi 110012. Price Rs. 30/-, Foreign $ 10.

The present volume is published in the state-of-the art report series. Of the non-depletable energy sources wind energy has been used for thousands of years to propel boats and ships; it has also provided rotary wind-mill power to replace human slaves. For rural areas, wind-mill has been an established technology in many countries. In recent years, modern technologies have been applied to develop wind mills of higher efficiency to convert wind energy into mechanical energy or electrical energy.

Author has given in this report a detailed analysis of wind energy and characteristics in chapter 1 and 2 for use in the conversion process. Wind energy potential for India is a useful addition in chapter one. Charts showing wind energy nature and patterns in different regions of India will be of immense interest to the readers and researchers who are working on the wind energy prablems for this country.

The next chapter contains energy conversion concepts which include different types of rotors, wind turbines etc. The chapter on performance parameters and data is an excellent review of the mathematical concepts which determine the efficiency of the conversion methods. A comparison of the various wind turbine concepts of modern technology is not so elaborate as would have been useful for a comprehensive idea on the recent trends.

In chapter 5, an account of small wind-mill developments is reported with special reference to India. The next chapter contains the description of medium and large wind electric generators developed or under development in the European countries and U.S.A.

From the report it is well recognised that the wind energy is a field which should be explored earnestly in India in view of the rural development programme. However, the achievement in India is insignificant so far in this field.

In conclusion, the assessment of the techno-economic feasibility given by the author does not indicate the wind energy to be competitive with known energy sources, but the former may be economic on a longer time scale.

In view of the present energy problem, unconventional renewable energy resources are being explored all over the world. Wind energy is one of those which can meet partial demand in the rural sector in India.

The status report given by the author, though not complete in technical details, at least, indicates its importance for R and D programme in India. Probably, this field in India can derive benefit by foreign collaboration, since the technologies in the foreign countries are well developed to be commercially used within the next five years.

Appendix 6 is referred to in the footnote on page 135, which is not found in the report. However, the report contains ready reference to the details of manufacturers of the wind turbines of foreign countries. The American Wind Energy Association is coordinating the manufacture of wind-mill and turbines in the U.S.A.

From the posibility of wind energy utilisation in India, it is high time for us to organise a similar association to consolidate the efforts of the private enterpraneurs to manufacture wind energy devices. The Council of Scientific and Industrial Research may develop the technical know-how and transfer it to the manufacturers through the association.

The present status report on wind energy should be given a serious consideration with no less importance than other unconventional energy programme in India. The obvious reason is its suitability for the rural population which constitute nearly 70% of the total. □

S. B. Karmohapatro

SCIENCE CORNER

Articles published in this section are for students and general readers for understanding science in the perspective of its fundamentals. We invite science teachers and scientists for contributing articles to this section. Also we shall appreciate comments from our readers on the articles published in this section.—*Ed.*

REFLECTIONS ON THE SCIENTIFIC ENTERPRISE

V. V. RAMAN*

SCIENCE, in the broadest meaning of the term, is as old as civilization itself. When, in the ancient world, man wondered at the heavens and wove stories about how the world came to be, he was doing science. When he speculated that all emerged from a single entity or computed the date of the next eclipse he was doing science also. But, like art and music, literature and philosophy, science in the ancient world was but another expression of civilization's creativity. It enriched human life without transforming it significantly.

With the rise of modern science, however, the situation changed dramatically : science began to take on a new and powerful dimension in human culture. It underwent a radical change in its methods and goals, and began to recognize more and more clearly the fruitfulness of the enterprise. Since the 17th century, science has been expanding in scope and growing in content with ever increasing intensity. By the 19th century it began to give more than a moral boost to the tentatives of technology. Indeed the wedding of science and technology was perhaps a circumstance of the greatest moment in human history. For by this process the most potent forces, both for supreme good and for devastating evil, have been released in the course of that history. And though perceptive commentators have predicted doom and destruction to mankind as well as the materialization of a terrestrial paradise as a result of this scientific-technological revolution, no prophet can be quite sure of what the ultimate consequence of it all will be in the centuries to come.

One unfortunate result of the close interactions between science and technology has been that the common man, and even many students and practitioners of science, have sometimes confused one with the other. Thus many tend to equate television and DDT, space exploration and nuclear weapons with science itself. What is more, whereas the gadgets and impacts of technology have penetrated many corners of the globe, the spirit and philosophy of the scientific world-view have not touched the masses even in the so-called advanced countries of the world. Pseudoscience and commercial exploitation of scientific jargon thrive in these countries as rampantly as superstitions did in the Middle Ages. In a country like India, with its long tradition of intellectual inquiry, science as a search for truth is of great appeal to its devotees; yet the weight of age-old worldviews and unscientific practices continue to have a gripping hold on the minds of the people.

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While it is undoubtedly of greater urgency to exploit the fruits of science and technology to eradicate misery and disease and to upgrade the level of human existence in the developing countries, it would be unfortunate if all this is done while letting the people at large think and function with medieval beliefs. The sad fact is that even the elements of micro-biology and astronomy have not reached the masses in many developing countries. Millions continue to believe that gods and goddesses cause smallpox and epilepsy, and that the winter solstice demands special prayers in places of pilgrimage.

At the same time, in the courses and programs that students of science and engineering follow in academic institutions there are few opportunities for them to reflect over the essential nature of the scientific enterprise, its conceptual foundations and philosophical assumptions. All too often they are influenced by the popular writings of thinkers who point to the limitations of science, to its narrow-mindedness in refusing to accept astrology and the occult, and argue that on the whole scientific truths are unreliable because they tend to change from generation to generation.

In the following series we will reflect over various aspects of the scientific enterprise, trusting that this will contribute to the elucidation of science as a major enterprise in human civilization.

Meanings of the Word Science

Like many other frequently used words, the term science does not admit of an easy or universally acceptable definition. The etymology of the word may be traced back to the Latin scientia which simply means : knowledge. In languages like German and Dutch also the word for science and knowledge are inter-related : Wissenschaft and Wetenschap. The older English word for science, natural philosophy, gave an additional color to the activity : as the word philosophy signified a love of knowledge. Classical Hindu philosophers spoke of different kinds of knowledge : gyana wisdom or knowledge of Brahman ; pragyana : intellectual intuition ; and vigyana : consciousness or worldly knowledge. This last term was also taken to mean science.

In any event, the word science in its modern connotation came to be used widely in English only from the 19th century onwards. A modern standard dictionary defines it as "any department of knowledge in which results of investigation have been logically arranged and systematized in the form of hypotheses and general laws subject to verification." Philosophers of science have looked upon science in different ways. In the 19th century, Herbert Spencer wrote : "Science is organized knowledge." To Thomas Huxley science was "nothing but trained and organized common sense, differing from the latter only as a veteran may differ from a raw recruit."

In all these and in similar definitions science is regarded as a vast storehouse of carefully arranged pieces of information. This view still persists. A modern author describes science as "knowledge that can be written down, forgotten, and learned again, with its form and content remaining unchanged."

But there is more to science than knowledge and systematization. Indeed there is another view of science which goes beyond the knowledge-content aspect of science. In this view science is a human enterprise, an activity that emeges from man's innate urges. Hence George Sarton's rhetorical question, "May we not say that whenever the attempt to solve a problem is made methodically, according to a predetermined order or plan we are witnessing the very growth of science ?"

This is certainly a much broader perspective of science. It brings out the fact that it is not simply knowledge that constitutes science, but equally the routes and reasons by which that knowledge is attained. When we are told that the sun is ninety three million miles away from the earth we tend to think that we are talking science, whereas when we hear that Asoka renounced arms after the Kalinga War, it sunds like history. Yet there is essentially little difference between the two statements in terms of our modes of understanding. Science includes the reasons one should be interested in knowing the sun's distance from us, in how one goes about determining that distance, and so on. In like manner, the methods of investigations by which scholars have unearthed information about Asoka and his exploits could well form part of the scientific enterprise.

Man interacts with the world around him in a variety of ways: with feelings and emotions, with intuition and speculation, as also with his intellect. The poet and the philosopher, the artist and the mystic, the activist and the relgious person, all respond to the world around them. And so does the scientist. Science is man's effort to grasp the universe of phenomena intellectually. In science one tries to comprehend the world in terms of reasons, relations and reference systems. In the scientific search and interpretation one seeks order rather than meaning, consistency rather than certainty. ☐

LETTERS TO THE EDITOR

Free amino acids of some regionally available medicinally important plant seeds

In recent years, there is an increasing realization of the hazards of protein malnutrition vis-a-vis intellectual dwarfing of children particularly in school age group[1]. In India, the majority of the people are vegetarians and depends for their need of protein on legumes and cereals which are rich in protein content and used medicinally[2,5].

Our general interest in the chemistry of medicinally important plants has promoted us to evaluate the protein and amino acid contents of some regionally available plant seeds[6-9]. Many workers studied the protein and amino-acid contents of non-edible and toxic seeds. In this paper, we wish to report the free aminoacids of some medicinally important seeds.

Two seeds of *Solanum xanthocarpum S. khasianum*, *Parkinsonia aculeata*, *Luffa cylindrica*, *Lantana camara*, *Centratherum anthelminticum*, *Argyreia speciosa*, *Amaranthus hybridus* and *Allium cepa* were used in the indigenous system of medicines for various ailments[2-5]. The air-dried powdered seeds were first extracted with light petrol to remove lipids, followed by extraction with 80% ethanol at 60°C till the extract gave negative ninhydrin test to isolate free amino-acid.

Test samples were prepared by treating ethanol-extract with activated charcoal or alumina to remove colouring impurity and then concentrated under vacuum. The aminoacids were purified by ion-exchange column-chromatography[12]. Dowex 50×4 (200 to 400 mesh), ammonium and hydrogen form resins were used for ion-exchange chromatography. The purified samples were concentrated and dissolved in aquous ethanol for isolation, separation and identification by uni- and two-dimensional paper chromatography[10-11] and paper eletrophoresis.

The amino acids were analysed by two-dimensional paper chromatography over Whatmann filter paper No. 1, using solvent systems Butanol ; acetic acid ; water (12:3:5) and phenol solvent : ethanol : ammonia (15 : 4 : 1). The spots were located by spraying with .2% ninhydrin in acetone and identified by comparing their Rf values with those of authentic samples under the identical condition and recorded in Table 1.

TABLE 1 : Free Aminoacids in plant seeds

Free Amino-acids ↓ / Plants →	Solanum xanthocarpum	Solanum khasianum	Parkinsonia aculeata	Lantona camara	Amaranthus hybridus	Centratherum anthelminticum	Argyreia speciosa	Allium cepa	Luffa cylindrica	Bu : A a : W	Ph. Et : Am.
Aspartic acid	—	+	+	+	—	—	—	—	+	23	06
Glutamic acid	+	+	—	+	—	+	+	+	+	28	12
Serine	—	+	+	—	—	—	—	+	—	22	22
Glycine	—	+	—	—	—	—	+	—	—	23	26
Threonine E	—	—	—	+	—	—	—	—	—	26	33
Alanine	+	+	—	+	+	+	—	+	+	30	41
Valine E	+	+	+	—	+	—	—	—	+	51	62
Isolecuine	+	—	—	—	—	—	+	—	+	67	71
Laucine E	+	—	+	—	+	—	+	—	+	70	73
Histidine E	—	—	+	—	—	+	—	—	—	11	50
Lysine E	+	—	—	—	—	—	+	—	+	12	57
Arginine E	—	—	+	+	+	+	—	+	+	15	66
Phenylalanine E	+	—	+	—	+	+	+	—	+	60	72
Tyrosine	—	—	—	—	—	+	+	—	—	45	43
Tryptophan	—	—	+	—	—	—	—	—	+	50	58
Proline	+	+	+	—	+	+	+	—	—	34	75
Hydroxyproline	—	—	—	+	—	—	—	—	—	22	44
Cysteine	+	—	+	—	—	—	—	—	—	08	05
Cystine	—	—	—	—	—	—	—	—	+	05	16
Methionine	—	+	—	—	+	—	—	—	—	50	62
α-Aminobutyric acid	—	—	—	—	+	+	+	+	+	40	53
Tourine	+	+	—	—	—	—	—	+	—	20	28

Note : + indicates the presence and
— indicates the absence of amino acid.

The presence of certain aminoacids such as lysine, histidine, arginine, cystine, glutamic acid and aspartic acid were confirmed by paper electrophoresis, using various buffer solutions (viz. buffer pH 1.9, pH 6.0, pH 8.0 and pH 11.5). Separation of aminoacids were carried out at 150 V, i.e. about 5 V/cm with initial current of 20-30 mA for 17 hr from a constant voltage source, spots were located by spraying with neutral, acidic and alkaline ninhydrin solution and the Rf values compared with authentic samples.

Aminoacids of similar nature having close Rf values were further confirmed by spraying with specific colour reagent[14-21], and comparison with the authentic samples.

Table 1 shows that *Parkisonia aculeata*, *L. Cylindrica*, *S. xanthocarpum*, and *A. hybridus* seeds are rich in essential aminoacids, while *S. khasianum* and *A. cepa* contains only one essential valine and arginine respectively. Lysine, an essential aminoacid generally present in most plant seeds, was found only in *S. xanthocarpum*, *A. speciosa* and *L. cylindrica*, which also contains the rare occurring amino-acid leucine. *P. aculeata* and *L. cylindrica* contains tryptophan while cystine is present only in *L. cylindrica*. Methionine is found in *S. khasianum* and *A. hybridus*.

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Effect of mineral nutrients on growth and essential oil formation in *Cymbopogon winterianus*

Citronella grass (*Cymbopogon winterianus* Jowitt), a native of Ceylon, was first introduced in Java in the early years of this century where it was very successful. This subsequently became popular as "Java citronella grass" and the oil as "Java citronella oil" in the essential trade. This oil is a widely-used raw material in perfumery, soaps, cosmetics and pharmaceutical industries. The annual requirement of the oil in the country was estimated at 500 tonnes. Java citronella was introduced into North-East India by the RRL-Jorhat in 1965. A number of studies have been done on the cultivation and improvement of this plant throughout India under varying cultural conditions. Some authentic compilations in this area of study are available in a number of research papers[1-8]. Available reports indicate that no attempt has been made on improvement studies of the plant with the application of mineral nutrients. The present study deals with the effect of mineral nutrients on the growth and essential oil formation of this important cash crop in the hilly tracts of Darjeeling, West Benagl.

Forty-day old seedlings grown from the slips of *C. winterianus* were transplanted in experimental plots (10 m^2) of Mungpoo Research Nursery (altitude 700 m), Darjeeling, at a spacing of 75 × 75 cm during April 1981 in a randomised-block design with three replications. The plots contained organically rich loamy soil. The plants were allowed to grow in natural conditions for another ten days. When the plants become established, they were subjected to the following experiments : (a) Treatments with different mineral nutrients, viz. Zn ($ZnCl_2$ as source), Mg ($MgCl_2$, $6H_2O$ as source), Mn ($MnCl_2$, $4H_2O$ as source), Fe ($FeCl_3$ as source); B (H_3BO_3 as source) and Mo (H_2MoO_4 as source) were done in three concentrations (1, 10 and 50 mgl^{-1}). (b) Treatments with different minerals as stated above in combination (considering two or three at a time), the concentration being 10 mgl^{-1}. In both sets, plants were fed with 30 ml/plant nutrients through leaves during the morning in five instalments followed by covering the plants with polythene bags for 1 hr. The plots were liberally watered as and when needed. Growth behaviour of the plants were examined by the study of total extension growth (cm), tiller formation and formation of leaves at 15-day intervals. The extraction and estimation of essential oil was done by "Hydro-distillation method" of Von-Rechenberg as described by Guenther[4]. Mean growth data of each plant as well as oil content of each treatment were analysed statistically and their percentage increase or decrease over control were calculated.

Significant increase in extension growth (Table 1) was revealed by the treatments with B 10 and 50 mgl^{-1} and Mg 50 mgl^{-1}, the maximum increase being observed in B 10 mgl^{-1} treatment. As regards tiller formation and leaf formation, the maximum increase occurred in Mn 10 mgl^{-1} treatment which also maximised the essential oil formation. Mo 10, B 10, Mg 1, Mn 50, Fe 10 and Mo 1 mgl^{-1} treatments were also considerably significant respectively. Mineral nutrients with other concentrations were inhibitory or without any significant effect. A maximum inhibition was noted in Zn 50 mgl^{-1} treatment.

A positive increase in extension growth (Table 2) was revealed by Fe+B only. Other treatments decreased the extension growth and a maximum decrease was observed in Zn+Fe treatment. Tiller and leaf formation

TABLE 1 : Effect of Zn, Mg, Mn, Fe, Mo and B on growth and essential oil formation in *C. winterianus*

Treatment		Percentage increase (+) or decrease (—) over control :			
(mgl^{-1})		Extension growth	Tiller	Leaf	Essential oil
Zn	1	—10.5	—21.2	— 7.8	—10.0
Zn	10	— 7.4	—21.0	— 3.1	—10.0
Zn	50	— 7.8	—29.6	— 4.5	—10.0
Mg	1	—12.0	+22.5	+14.3	+30.0
Mg	10	— 5.0	—27.9	— 8 8	—10.0
Mg	50	+ 8.8	—24.5	— 4.2	—10.0
Mn	1	— 0.7	+ 2 2	+ 2.3	+ 3.0
Mn	10	— 6.9	+37.7	+23.3	+50.0
Mn	50	— 2.9	+15.0	+12.5	+25 0
Fe	1	+ 2.6	+ 3.6	+ 5.4	+10.0
Fe	10	+ 3.2	+12.4	+10.9	+20.0
Fe	50	+ 6.9	+ 3.3	+ 4.8	+10.0
Mo	1	+ 3.8	+10.6	+10.2	+20.0
Mo	10	— 3.5	+32.7	+20.5	+40.0
Mo	50	—11.2	—28.7	— 8.2	—10.0
B	1	+ 3.8	—20 4	— 4.0	0
B	10	+12.8	+23.7	+16.2	+30 0
B	50	+10.5	—13.4	— 2.1	0
Control		142.3(cm)	25.2	167.4	1.0%

TABLE 2 : Effect of different mineral nutrients on growth and essential oil formation in *C. winterianus*

Treatment	Percentage increase (+) or decrease (—) over control :			
(10 mgl^{-1})	Extension growth	Tiller	Leaf	Essential oil
Zn+Mg	—11.9	+13.4	+ 9.8	+20.0
Zn+Mn	—13.9	—21.3	— 9.5	—10.0
Zn+Fe	—16.1	—41.3	—29.2	—60.0
Zn+B	—10.2	—22.3	—15.7	—25.0
Zn+Mo	— 3.2	—24.7	— 8.3	—10.0
Mg+Mn	— 5.5	+34.7	+28.2	+45.0
Mg+Fe	— 9.2	+29.5	+21.1	+40 0
Mg+B	— 4.8	+ 8.7	+ 6.3	+15.0
Mg+Mo	—15.2	—22.1	— 2.0	0
Mn+Fe	— 9.8	— 5.9	— 3.1	0
Mn+B	—13.9	+21.4	+14.2	+30.0
Mn+Mo	— 0.5	+18.1	+12.2	+25.0
Fe+B	+16.1	—15.9	— 3 2	— 5.0
Fe+Mo	— 2.8	+16.5	+11.5	+25.0
Mo+B	— 6.6	+22.5	+17.8	+30.0
Control	142.3(cm)	25.2	167.4	1.0%

were enhanced by the treatments with Mg+Mn; Mg+Fe; B+Mo; B+Mn; Fe+Mo; Mn+Mo and Zn+Mg respectively; maximum enhancement being noted in Mg+Mn treatment. Essential oil synthesis was augmented considerably in those treatments where the formation of leaf and tiller was enhanced. A considerable reduction in essential oil biogenesis was revealed in treatments with Zn+Fe and Zn+B.

Extension growth was not remarkably increased in any treatment (Table 3) whereas Mg+Mn+B decreased the same by 18.8%.

TABLE 3: Effect of different mineral nutrients on growth and essential oil formation in *C. winterianus*

Treatment	Percentage increase (+) or decrease (—) over control :			
(10 mgl^{-1})	Extension growth	Tiller	Leaf	Essential oil
Zn+Mg+Mn	+ 0.5	+12.9	+10.0	+20.0
Zn+Mg+Fe	— 6.9	—26.0	—16.8	—25.0
Zn+Mg+B	— 7.1	—14.5	— 6.4	— 5.0
Zn+Mg+Mo	— 9.3	+17.5	+12.3	+25.0
Mg+Mn+Fe	—14.4	+ 9.7	+ 6.2	+ 5.0
Mg+Mn+B	—18.8	—14.0	— 3.8	— 5.0
Mg+Mn+Mo	— 9.1	—20.5	—13.3	—15.0
Mn+Fe+B	+ 0.1	—15.9	— 5.8	— 5.0
Mn+Fe+Mo	+ 0.8	+ 8.1	+ 7.3	+ 5.0
Fe+B+Mo	— 0.6	—24.2	—14.4	—15.0
Control	142.3(cm)	25.2	167.4	1.0%

Only 20% augmentation in essential-oil biogenesis was revealed by both Zn+Mg+Mn and Zn+Mg+Mo treatments when both tiller and leaf formation concomittently increased. The effect of all other treatments were either inhibitory or insignificant. A maximum inhibition in tiller; leaf and oil formation was noted in treatment with Zn+Mg+Fe 10 mgl^{-1}.

The plant *C. winterianus* was successfully grown in Eastern Himalayan hilly tracts of Darjeeling (West Bengal) for the first time. The effect of other mineral nutrients, viz. N; P and K on essential oil synthesis in *Cymbopogon* have been variously reported[4,5]. Foliar application of mineral nutrients on growth and oil formation in *C. winterianus* revealed some interesting findings. The effectiveness of different nutrients on increasing the oil content has been manifested differently when applied singly or in combination.

Of the growth parameters studied; the rates of leaf and tiller formation revealed a close agreement with the rates of essential-oil biogenesis. Those treatments which augmented the rate of leaf and tiller formation concomittently augmented the rate of essential oil biogenesis. The relationship between extension growth and essential-oil synthesis could not be established in this plant species.

Significant augmentation in the biogenesis of essential oil in *C. winterianus* was revealed in treatment with Mn; Mo; Mg and B. About 50 and 40% increase by Mn and Mo 10 mgl^{-1}; respectively and a 30% by Mg 1 and B 10 mgl^{-1} were observed in this study. All these four minerals; two in cationic forms (Mn^{++}; Mg^{++}) and two in anionic forms (MoO_4^{---}, BO_3^{---}) are related with the activation of enzymes in nitrogen metabolism[6]. This may be a possible pathway for the biogenesis of amino-acids which are capable of being translocated into the site of essential-oil synthesis and ultimately used during the synthesis of monoterpenes[7].

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Host range of the cucurbit mite, *Tetranychus neocaledonicus* Andre (Tetranychidae : Acarina)

The cucurbit mite, *Tetranychus neocaledonicus* Andre (Tetranychidae : Acarina), which has been reported earlier under synonyms *T. cucurbitae* Rahman and Sapra and *T. equatorius* McGregor, was observed to attain pest status on cucurbits in Udaipur and other cucurbit growing areas of Rajasthan. It inflicted heavy injury on foliage by sucking the sap with its stylets, leading to poor yield. A perusal of available literature revealed that no host-range studies of this pest species in this part of the country,

TABLE 1 : Host range of *T. neocaledonicus* Andre.

Family	Botanical name	Common name
Caricaceae	*Carica papaya*	Papaya
Compositae	*Bidens pilosa*	Bidens (Weed)
	Helianthus annus	Sunflower
	Xanthium strumarium	Cockle-bur
Convolvulaceae	*Ipomoea botatas*	Sweet potato
	Ipomoea palmata	Railway creeper
Cruciferae	*Brassica campestris*	*Sarson*
	Brassica oleracea	Cabbage
	Raphanus sativus	Radish
Cucurbitaceae	*Cucurbita moschata*	Pumpkin
	Cucumis sativus	Cucumber
	Lagenaria sicerarla	Bottle gourd
	Luffa acutangula	Ridge gourd
	Luffa cylindrica	Sponge gourd
	Momordica charantia	Bitter gourd
Euphorbiaceae	*Acalypha triculour*	Acalypha
	Euphorbia hirta	Euphorbia
	Ricinus communis	Castor
Geraniaceae	*Pelargonium grandiflorum*	Geranium
Graminae	*Pennisetum typhoides*	*Bajra*
Labiatae	*Ocimum sanctum*	*Tulsi*
Leguminosae	*Dalbergia sissoo*	*Shisham*
	Melilotus parviflora	*Senji*
	Pisum sativum	Pea
Malvaceae	*Althea rosea*	Hollyhock
	Gossypium hirsutum	Cotton
	Hibiscus esculentus	*Bhindi*
Meliaceae	*Melia azadarach*	Melia
Moraceae	*Ficus carica*	Fig
Nyctaginaceae	*Bougainvillea spectabilis*	Bougainvillea
Onagraceae	*Clarkia elegans*	Clarkia
Papilionaceae	*Cajanus cajan*	*Arhar*
	Glycine max	Soybean
	Medicago sativa	Lucerne
	Phaseolus spp.	Beans
	Phaseolus mungo	Black gram
Papveraceae	*Papaver orientale*	Poppy
Rosaceae	*Rosa indica*	Rose
Solanaceae	*Lycopersicum esculentum*	Tomato
	Solanum melongena	Brinjal
	Solanum tuberosum	Potato

which offers different flora on account of its arid and semi-arid regions, have been undertaken. The only published record of *T. neocaledonicus* from semi-arid region of Rajasthan is that of Pande and Yadava[1] on brinjal. From other parts of the country and abroad, it has, however, been recorded as a polyphagous pest[2-7].

A field survey was conducted in Udaipur and its surrounding areas to scan *T. neocaledonicus* infesting flora. Preliminary identification was undertaken by the authors themselves. Thereafter, some of the specimens were sent for identification to the Zoological Survey of India, Calcutta and to the Department of Entomology, University of Agricultural Sciences, Bangalore, for confirmation.

The survey for the mite species under field conditions has revealed that there were 41 plant species belonging to 18 families which harboured all the stages of *T. neocaledcnicus* (Table 1). Usually the mites were observed confining themselves to the dorsal surface of the leaves of these plants. However, during serious infestation they crawled over the ventral surface also.

The present study adds three plants, *viz. Xanthium strumarium*, *Cucurbita moschata* and *Acalypha triculour* to our knowledge of the host range of this species. All the hosts reported here, except brinjal, have been recorded for the first time in Rajasthan.

The authors are thankful to Dr. C. L. Kaul for his valuable suggestions.

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Colorimetric determination of methamidophos by cholinesterase inhibition

Methemidophos (O. S—Dimethyl Phosphoramidothioate), an insecticide with contact and systemic activity, is effective against a wide range of insect and mite pests on many crops and is recommended at the rate of 0.5 to 1.0 kg active ingradient per hectare. As the candidate insecticide is relatively new, awaiting registration for Indian Agricultural use, it is necessary to study the dissipation of its residues in/on crop plants from the consumers' health point. Of the two analytical methods described for the estimation of residues of methamidophos, one is a gas chromatographic method (GC) with a thermionic detector which is both sensitive and specific and the other is a thin-layer chromatographic method (TLC) which lacks sensitivity, however, its usefulness is limited for confirmation purposes only[2]. The procedure detailed hereunder is essentially a cholinesterase (ChE)-inhibition method applicable for the determination of monocrotophos residues in plant material (Communicated by Ciba-Geigy of India Ltd., Bombay). Same methodology was adopted to quantity methamidophos from the fortified leaf samples of cowpea, through recovery assays and its further relevance in the determination of its residues, is presented in this report.

ChE inhibitors (insecticide as well as naturally occurring components) present in the sample were extracted by maceration in chloroform. After repeated evaporations (on flash evaporators); this concentrated medium was transferred to hexane. Inhibitor materials in hexane were concentrate and then transferred to water and the organic layer containing pigments were partitioned and separated after centrifugation at 3000 rpm for 10 min. An aqueous solution of insecticide (or water containing the inhibitors) is added to buffered solution (pH 8) of ChE present in blood plasma. These contents were mixed and incubated with butyryl thiocholine (BUTCH) and 5.5'-dithiobis-2-nitrobenzoic acid (DTNB). Thiocholine formed upon substrate hydrolysis by non-inhibited ChE; reduces DTNB to its yellow anion (5-thio-2-nitro benzoic-acid) and the absorbance of which is colorimetrically determined at 420 nm. Under rigid conditions of experimentation; per cent ChE inhibition with reference to non-inhibited blank is a measure of amount of inhibitor, present in the sample.

TABLE 1 : Estimation of Methamidophos residues in fortified Cowpea leaf samples

Amount of Methamidophos fortified (μg)	Amount of Methamidophos recovered (μg)*	Recovery** (%)
5	4.25	85.0
10	8.20	82.0
15	12 75	85.0
20	18.00	90.0
25	22.25	89.0

* Reference curve was established for the quantity of technical methamidophos vs ChE inhibition percentage with reference to non-inhibited blank as 100% active. Corresponding to the inhibited enzyme, the amounts of inhibitor (insecticide) were extrapolated from the above curve and due corrections were attended to.

** With reference to the fortification level of the insecticide, recovered amounts were expressed as recovery percentages.

The results from the recovery tests conducted with five fortification levels (5, 10, 15, 20 and 25 μg) of technical methamidophos to 100 g cowpea leaf sample (for each level) are presented in Table 1.

In the present study, recoveries of methamidophos ranged from 82 to 90% at different levels of fortifications. Recoveries of 73 to 106% of Monitor (methamidophos), from wide variety of crops by GC method of analysis (majority of the recoveries in the order of 90 to 100% at 0.05-0.1 ppm of added insecticide have been reported[2]. The sensitivity of the present enzymatic inhibition method was 0.05 ppm of methamidophos, while still lower limits of 0.003 to 0.005 ppm were observed with the GC. Maximum residues limits (MRL) or tolerance levels of methamidophos set by FAO/WHO for different crops[1] were as follows : 0.1 mg/1 kg for cotton seed, rape seed, potato and sugarbeets ; 1 mg/1 kg (for brussel sprouts, cabbage, cucumber, egg plant, peaches, pepper and sugar beet leaves), 2 mg/1 kg (for broccoli, cauliflower, celery, lettuce, and tomatoes) and 5 mg/1 kg (for hops). Even with the less sensitivity (0 05 ppm) observed in the present enzymatic inhibition approach, (compared to the recommended GC method) no possible health risks to consumers are contemplated as the tolerance levels (0.1-5 mg/kg) on any crop were always higher than this sensitivity level.

Experimental methodologies for Azodrin (monocrotophos), phorate, phosphamidon and other insecticidal residues through enzymatic assays involving ChE inhibition are more sensitive than non-enzymatic methods. Comparable results with enzyme inhibition and GC procedures for the determination of insecticidal residues have been reported by few workers[3]. Hence, this enzyme-assay procedure involving blood plasma as a source of ChE and BUTCH—DTNB, as substrate-working reagents forms an alternative, for regulatory purpose in the absence of sophisticated and expensive equipment like GC. The only limitation identified with enzymatic assays is that the method is not applicable for mixtures of ChE inhibitors, but this difficulty can be overcome by the separation of mixed residues.

The authors are grateful to Rallis India Ltd., R & D Laboratory, Bangalore, for the supply of Technical chemical of methamidophos. The senior author is thankful to ICAR, New Delhi, for the financial assistance in the form of senior fellowship.

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SEMINAR ON CALCUTTA BEYOND 2000 A. D.

The Indian Science News Association in collaboration with the Department of Science and Technology, Government of India ; Calcutta University ; CMDA ; Calcutta Corporation and a few other bodies, is organising a Seminar on "Calcutta beyond 2000 A. D." during the second week of February, 1984. The following areas are proposed to be covered in the Seminar :

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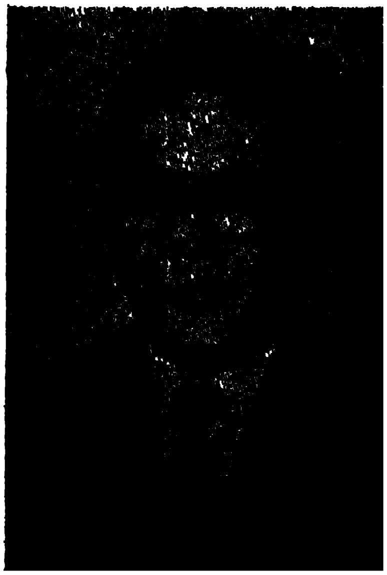
Persons interested to participate and attend the Seminar, are requested to contact the Secretary, Indian Science News Association, 92, Acharya Prafulla Chandra Road, Calcutta : 700009.

SEVENTY-FIRST INDIAN SCIENCE CONGRESS RANCHI. 1984

SHORT LIFE-SKETCH OF GENERAL PRESIDENT

RAM PRAKASH BAMBAH

Professor Ram Prakash Bambah was born on 30th September 1925 at Jammu. He had his school education at Wazirabad and Sialkot. He went to college at Govt. College, Lahore. Besides obtaining a high rank in his Matriculation examination he stood first in the Panjab University in F.A., B.A., B.A. (Hons.) and M.A.—in the last examination he secured 600 marks out of 600—a record unequalled in the history of the University.



After a brief spell as a Research student of Professor S. Chowla, he joined Delhi University as a Lecturer (in a leave vacancy) in the Physics Department, just before partition In 1948 he proceeded to St. John's College Cambridge as an 1951 Exhibition Scholar. He received his Ph. D. in 1950 under the supervision of Professor L. J. Mordell. He spent the year 1950-51 at University College, London. During this year he wrote joint papers with H. Davenport, C. A. Rogers and K F Roth.

Bambah retutned to India in 1951. Unable to find a job, he applied to the National Institute of Sciences of India, who gave him a Research Fellowship for six months on an ad-hoc basis. In April 1952, he was almost simultaneously offered a Readership in the Panjab University, elected to a Fellowship of St. John's College, Cambridge and appointed a member of the Institute for advanced Study, Princeton On his assurance that he would eventually like to work in India, Diwan Anand Kumar, Vice-Chancellor Panjab University at the time, gave him leave for two years immediately after joining the University. He spent these two years at Princeton and Cambridge. In 1954 the Panjab University started post-graduate classes in the Mathematics Department consisting of only two members—Professor H. Gupta and Dr. R. P. Bambah. Professor Gupta with the assistance of Bambah started the process of building up this department which is now recognised as an advanced Centre by the UGC and is known in the world of Mathematics as a leading school of research and training. The Department at the moment has a staff of 30, with nine full Professors. Bambah became a Professor in 1958. He obtained the Sc. D.

degree of Cambridge in 1970 on the basis of his published work. He was elected to a Fellowship of the Indian National Science Academy in 1955.

Bambah has todate written sixty-one papers and the theses of his students have resulted in twenty-four other papers. He has made contributions to congruence properties of arithmetical functions, sums of two squares, methods of finding critical determinants of nonconvex regions, non-homogeneous forms, lattice and non-lattice coverings by spheres and other sets, Minkowski's second theorem, Minkowski's conjecture on nonhomogeneous linear forms, values of nonhomogeneous indefinite quadratic forms and other topics of Number Theory and Discrete Geometry.

He visited U.S.A. as an NSF Lecturer for summer schools in 1960 and as a Visiting Professor at Notre Dame University in 1957-58. He was a regular Professor at Ohio State University from 1964 to 1970 and has frequently worked as a Visiting Professor there since then He was a UGC National Lecturer in 1971 and a UGC National Fellow from 1973 to 1975. He is a recipient of the Srinivas Ramanujan Medal of the Indian National Science Academy.

Bambah has been Editor, Journal of the Indian Mathematical Society and member, Board of Editors, Indian Journal of Pure and Applied Mathematics. He has been one of the Editors of the Journal of Number Theory (published by Academic Press) since its inception. He has been President of the Mathematics Section of Indian Science Congress and was President of the Indian Mathematical Society in 1969-70. He is a Fellow of all the three National Academies: Indian National Science Academy (F.N.A.), Indian Academy of Sciences (F.A.Sc.) and National Academy of Science of India (F.N.A.Sc.). He presided over Physical Sciences Section of the 48th session of the National Academy of Sciences of India and was Vice-President of INSA for the years 1979-1980.

He was a member of the first UGC Review Committee on Mathematics and convener of the Indian Steering Committee for the Binational Conference on Mathematical Education and Research. He was a member of the Gajendragadkar and Sen Committees on the Governance of Universities. He served as a member of the University Grants Commission from 1976 to 1979. He is currently a member of the Panjab Education Reform commission and the National Commission on Teachers. ☐

SHORT LIFE-SKETCHES OF SECTIONAL PRESIDENTS

G. P. SRIVASTAVA

Section of Physics

Prof. G. P. Srivastava was born in Varanasi, India on 16th June, 1933. He completed his M.Sc. in Physics (Electronics) and Ph.D. (Microwave from University of Allahabad, India in 1954 and 1957 respectively). From 1955-58 he served as Assistant Professor of Physics in University of Allahabad. In 1958 he joined as Assistant Professor in the University of Gorakhpur and then in 1962 he joined University of Jodhpur and worked there as Reader in Physics. In 1965 he joined department of Physics & Astrophysics, University of Delhi as a Reader. In 1974 he became Professor of Physics in the same department and presently he is Head of the Department of Physics and Astrophysics and Dean of Faculty of Sciences, University of Delhi.

Prof. G. P. Srivastava has worked in the fields of Microwave and Quantum Electronics. Main contributions are in the fields of Microwave Spectroscopy, magnetomicrowave effects, Gunn effect, Microwave components, stripline, and laser induced nonlinear optical effects. Significant contributions has been made in the study of microwave spectra of hydrogen bonded molecules. He for the first time had observed the rotational transition of hydrogen bonded molecules.

He has also made significant contributions to explain the transport phenomenon in many important semiconductors links Gallium arsenide, Gallium phosphide, Cadmium sulphide by considering all the important scattering mechanism simultaneously.

In the field of Quantum Electronics, he is working on nonlinear optics. The effect of spatial and temporal profile on second harmonic generation has been investigated. He has also observed multiphoton absorption and second harmonic generation processes in many organe metallic compounds.

Microwave components like circular-waveguide-hybrid-T have been developed and fabricated in his laboratory. Besides that, a comprehensive study of the beam shaping of the radiation pattern of rectangular waveguide and sectoral horns by flange techniques has been made.

Recently, he has made some significant contribution in the field of magnetic-microwave Kerr effect (MMKE) in the ferrites.

Since 1976 he has made some significant contribution in the field of Solar Cells. Recently he was invited to give a talk on non-uniformities of ultrathin oxide layers in MOS Solar Cells in an International Conference held at Vigyan Bhawan (Nov. 23-28, 1981).

Twenty six students have obtained Ph.D. degree under his supervision so far. His present fields of interest are Microwave Antenna, Solar Cells, Non-linear optics and EPR.

He has published about nine hundred and twenty five/papers in research journals of national and international reputation.

He has organised teaching laboratories when University of Gorakhpur and Jodhpur started. Teaching of Electronics has been organised by him in University of Delhi, Department of Electronics, Government of India had, recently, entrusted him with

Organisation of Special M.Tech. course at University of Delhi. This may result in setting up a Department of Applied Physics in the University of Delhi.

He is Fellow of National Academy of Sciences (Allahabad) and senior member of Institute of Electronics and Electrical Engineers.

He has been chairman of Microwave Theory and Technique Chapter of IEEE (India Branch). □

S. K. BANERJI

Section of Chemistry

Prof. Samir Kumar Banerji was born at Ahmedabad (Gujarat), educated at St. Xavier's (Ahmedabad), Ewing Christian College, (Allahabad) and University of Allahabad, from where he obtained the M. Sc., and D. Phil degrees.

Has a total teaching experience of more than 35 years, teaching at Meerut College, Meerut and Birla Institute of Technology and Science, Pilani.

Chaired the Department of Chemistry at BITS for over 12 years, and has had considerable experience of setting up teaching and research laboratories. Built up and organized courses at various levels, of teaching and research.

Has been working on coordinate compounds and metal chelates for the past several years, on aspects of composition, stability and thermodynamics of complex systems.

Currently working on the application of metal chelates to biological systems, bio-industrial reactions, public health problems and bio-inorganic chemistry.

Guiding an important area of recovery of valuables in waste from viscose rayon industries in the area of waste management.

Has published nearly 150 research papers in journals of international repute. Some of the work done has been quoted in several standard books. Authored text books.

Over the years numerous students have worked under his supervision of M.Sc./First Degree Research projects in diverse topics. Several students have worked for their Ph.D. degree in the areas of metal chelates and complexes, thin film solar-cells, bio-inorganic chemistry.

Is a member of several national organizations and a Fellow of the National Academy of Sciences. Has been elected to several positions of responsibility including the Council, of the Indian Chemical Society. Elected member of the Sectional Committee in Chemistry of Indian Science Congress several times.

Scientist-in-charge—Industrial Chemistry of the Chemists Convention 1979-81, when several symposia were arranged with national paricipation, which evinced considerable interest.

Acted as a member of the Examination Reform Implementation Committee of the University Grants Commission. And was a member of V and VI Plan Visiting Committee to several Universities.

Worked as an Expert Member of Research Boards of Universities, Council of Scientific and Industrial Research, University Grants Commission, Public Service Commissions and several National Agencies.

Has visited Bulgaria on Cultural Exchange project. Europe on study-cum-lecture tour and United Kingdom on a British Council □

S. K. TREHAN

Section of Mathematics

M.Sc. in 1952 from Delhi University. Ph.D. in 1958 from University of Chicago. Government of India Scholar 1954-57. Reader, Delhi University 1962-67. From 1967 to to-date Professor of Applied Mathematics, Panjab University, Chandigarh.

Field of Specialization: Magnetohydrodynamics.

> Have written 47 research papers in International Journals of repute. Wrote two review articles on 'Plasma Oscillations' and these have been identified as a source material on the subject and reproduced with the authors permission by the American Institute of Physics under the Scheme 'Selected Reprints' in the book "Small Amplitude Waves in Plasma". The author was the first one to investigate the Stability of Force-Free magnetic fields and these have widely referred to including the Physics Handbook (a Compendium of Physics exceeding 50 volumes published by Springer Verlag—Vol. 51, page 718).

Distinctions obtained

1971—Visiting Fellow, Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, Colorado.
1975—Senior Research Associate of the National Research Council, U.S.A. to work at Goddard Space Flight Centre, NASA, Greenbelt, Md.
1976—Awarded the Shanti Swarup Bhatnagar Prize in Mathematical Sciences.
1976—Elected Fellow of Indian National Science Academy.
1978—Elected Fellow of Indian Academy of Sciences.
1978—Elected Fellow of the National Academy of Sciences.
1977-78—UGC National Lecturer.
1979-82—Editor of Publications, INSA.
1982-83—UGC National Fellow. □

K. C. SEAL

Section of Statistics

Dr. Kiron Chandra Seal is the youngest son of late Shri U. C. Seal, who belonged to the West Bengal Civil Service, and was born on September 1, 1929 at Bishnupur, West Bengal. He had a brilliant academic career and his name featured in the merit list in all the examinations of the Calcutta University starting with the High School examination. During his entire college years, Dr. Seal also served in the University Officers' Training Corps and underwent military training. He attained the rank of Company Sergeant Major in University Officers' Training Corps He acquired Master's degree in Statistics in 1949 from the Post-Graduate College of the Calcutta University and secured the first position in Class I. Thereafter he worked as a Senior Research Scholar in the Research and Training School of the Indian Statistical Institute from February 1950 to June 1951. During this period, he taught theoretical and applied statistics to Post-Graduate trainees of the Indian Statistical Institute and the trainees of the International Statistical

Education Centre. He left the Indian Statistical Institute towards the middle of 1951 and worked in one of the textile mills in Ahmedabad for introducing Statistical quality control system in the mill under the guidance of Ahmedabad Textile Industrial Research Association. Towards the beginning of 1952, he was appointed as the Statistical Officer in the Damodar Valley Corporation where he was entrusted with the task of setting up of the statistical section. Towards the middle of the same year (1952), he was awarded Smith-Mundt Fulbright Scholarship of the U. S. Government to prosecute higher studies and research in Mathematical Statistics in U. S. A. He spent one academic year (1952-53) in the Princeton University in the Department of Mathematics; he passed the qualifying pre-doctorate examination in the Princeton University and was awarded A M. degree in Mathematics with Statistics. He left Princeton University in 1953 to spend one academic year (1953-54) in the Department of Mathematical Statistics in the University of North Carolina, Chapel Hill, NC, U.S A. He carried out Post-graduate Research under Prof. R. C. Bose and was the first student in the University of North Carolina to receive his Ph.D. degree in just one year. On his return from U.S.A., Dr. Seal resumed his duties as the Officer-In-charge of the Statistical Section of the Damodar Valley Corporation (DVC). During this period, he also served as a part-time Lecturer in Statistics in the University of Calcutta, where he taught theoretical and applied statistics to the Post-graduate students of the Department of Statistics, Calcutta University.

In September 1957, Dr. Seal joined the Planning Commission, Government of India as a Senior Research Officer and remained in-charge of statistical studies relating to planning and manpower and other facilities in the Health sector of the economy. He left Planning Commission in August, 1959 to join Labour Bureau, Ministry of Labour, as its Senior Deputy Director. As the Officer-In-charge of the Statistics Division of the Labour Bureau, Dr. Seal was responsible for collection and analysis of various labour statistics at the national level. At that time, he also was actively associated with planning, design and report writing of large scale socio-economic surveys covering various aspects of industrial labour. He was promoted as Director, Labour Bureau in January, 1964, where he guided all the projects handled by the Labour ureau; these pertained to not only large scale field surveys but also in-depth labour and man-power studies relating to industrial and agriculture labour in India. He went on a U.N. assignment on deputation from the Government of India to work as ILO Regional Expert on Manpower Projections in the ILO Regional Office for Asia at Bangkok in July, 1967. He was responsible for preparation of manpower plans in Asian countries, making employment and training projections and setting of targets at the national, sub-regional and regional levels. On completion of his deputation in August, 1970, Dr. Seal served as a Joint Director in the Central Statistical Organisation and ex-officio Director of the Statistics and Surveys Division of the Planning Commission for about a year. In July, 1971, he joined the Department of Family Planning in the Ministry of Health and Family Planning as Director, Planning and Evaluation and was responsible for all work pertaining to programme analysis and evaluation, perspective Planning, cost-benefit and cost-effectiveness studies and target setting in family planning programmes. He was also made responsible for over-viewing the demographic research work undertaken in the country. In June, 1974, Dr. Seal joined the Planning Commission as an

Adviser in-charge of Labour, Employment and Manpower Planning; he was closely associated with the formulation of labour, employment and manpower policies; he also provided technical guidance in various analytical studies pertaining to planning problems in these fields. From November, 1975, he was entrusted with the additional responsibility of Adviser in-charge of Health, Family Welfare and Nutrition in the Planning Commission. In March, 1978, Dr. Seal joined the Central Statistical Organisation as its Director; the post was subsequently redesignated as Director-General, Central Statistical Organisation and Additional Secretary in the Department of Statistics. In this post, he is currently providing guidance and supervision of the entire technical and administrative work pertaining to the maintenance of statistical standards, coordination of statistical activities of Central Ministries and State Governments, preparation of national accounts, statistical training of government officials at the national level, compilation of industrial statistics and liaison with international statistical agencies.

Dr. Seal is a member of a large number of research associations and organisations, such as Indian Statistical Institute; Indian Association for Study of Population; Calcutta Statistical Association; Indian Science Congress Association; International Statistical Institute; International Association of Survey Statisticians etc. Dr. Seal had also been associated with many national and international committee dealing with statistical problems relating to a wide range of area. Important among them are the committee, on which he served as Chairman, set up by the Government of India to review the National Statistical System; the Expert Committee set up by the Ministry of Labour for preparation of a New Series of Consumer Price Index Number with 1980-81 as the base year and a Review Committee on Compilation of Labour Statistics; Working Group on Trade Statistics set up by the Ministry of Commerce. He also served as a member of the high level committee on Educational Statistics set up by the Ministry of Education. Dr. Seal is a member of WHO Expert Advisory Panel on Health Statistics and the Advisory Council of the Statistical Institute for Asia and the Pacific, Tokyo. He has represented the country in the U. N. Statistical Commission meetings held during the last five years.

Dr. Seal has published a large number of technical papers. Initially his interest was on theoretical problems and his papers had been published in Sankhya, Annals of Mathematical Statistics; Journal of American Statistical Association; Calcutta Statistical Association bulletin etc. For his paper on 'Generalisation of Product Formula' published in the Journal of Indian Society of Agricultural Statistics, which was adjudged the best research paper, published in that journal during the two-year period 1957 and 1958, he became the first recipient of the award of the Indian Society of Agricultural Statistics, presented to him by the then President Dr. Rajendra Prasad. However, after joining the Government, his interest shifted towards research in the applied field. A large number of research and review papers in different branches of statistics have been published by Dr. Seal, mostly in the Indian journals. He has also contributed a large number of technical papers for the use of several international organisations, like, ILO, WHO, FAO and UNESCO. □

D. N. DE

Section of Botany

Dr. Deepesh Narayan De, Professor of Applied Botany, Head of Agricultural Engineering Department and Co-ordinator, Biosciences and Bioengineering Centre, Indian Institute of Technology, Kharagpur, is a leading molecular cytogeneticist of the country, who believes that the salvation of life sciences lies in the experimental areas relying heavily on physical and chemical methodologies.

Born on July 31, 1933, the nurture of Pabna located in the lush green riverain tracts between the Brahmaputra and the Padma, in East Bengal, ushered Deepesh to Botany Honours at Presidency College, Calcutta for B.Sc. in 1952. Early in his M.Sc. days, he was charmed by the scintillating lectures of a young highly energetic teacher Prof. Arun Kumar Sharma who opened the doors of genetics and 'tetranucleotide DNA', to him. As the 'double helix' was born somewhere else, inspired by the unflinching determination of his *Guru* to unravel the mysteries of cell and chromosome, as well as numerous illuminating discourses, the shy humble disciple gathered enough courage to undertake a research project which culminated in an M.Sc. thesis (in lieu of a special paper) proffering five publications including four in foreign journals. He earned First Class First position in M.Sc. Botany in 1954, University Gold Medal, A. K. Mitra Silver medal and other prizes.

With the laurels he proceeded a few months later to Carnegie Institution of Washington, Cold Spring Harbor, New York and started his work under Dr. B. P. Kaufmann, the doyen of chromosome structure. he also got himself associated with Brookhaven National Laboratory and worked with electron microscope when the instrument was still in its infancy. Within a few months he revealed the ultrastructure of chromosomes (1956). He was also the first to study the ultrastructure of nuclear membrane of plant cells, origin and development of mitochondria and golgi bodies. In 1957, he joined Columbia University, New York to work under Prof. J. Herbert Taylor who had just made the epoch-making discovery of semiconservative mode of chromosome replication. He earned his Ph.D. in 1960 from Columbia, on his finding that DNA and histones are synthesized concomitantly and nuclear nonhistones are synthesized before and after 'S' phase. After a long tour of Europe he returned home and joined Biophysics Division of Saha Institute of Nuclear Physics, Calcutta as a Pool Officer in 1961 and worked on the mechanism of radiation damage at the cellular level. After a short stint at Kalyani University in 1962, he joined Indian Institute of Technology, Kharagpur as an Assistant Professor in Applied Botany and began preaching and practicing modern biology. On an Alexander Von Humboldt Senior Faculty fellowship, Prof. De worked on callus culture and stabilization of haploidy at Max-Planck-Institut für Züchtungsforschung at Cologne, West Germany during 1968-69.

Prof. De and coworkers have made significant contribution on macromolecular organization and fluorescence phenomena of chromosomes, ultrastructure of cellular differentiation and origin and cytogenetics of grain legumes. On the basis of electron microscopy, autoradiography and enzyme studies, he established the role of histones in chromosome coiling and nonhistones as scaffold protein. He proposed a model of chromosome which has been widely discussed.

He worked with fluorescence molecular probe for dye-dye interaction and energy transfer, autofluorescence of nucleoproteins and its photodegradation for the comprehension of chromosome architecture. Lately he and coworkers discovered the phenomenon of photoenhancement of acridineorange-induced secondary fluorescene of biomolecules and demonstrated the photodynamic denaturation of DNA *in situ* for the first time. The mechanism of drug detoxification of cells through vacuolar autophagy has also been established by them.

His electron microscopic work on the cellular differentiation in meristematic, ageing and symbiotic tissues has been widely acknowledged. The studies on ultrastructure and physiology of *Rhizobium-Phaseolus* in terms of extracellular polysaccharide, enzyme profile, etc. reveal certain basic features of host-symbiont recognition and interaction.

With the aid of a wide spectrum of methodologies including intergeneric and interspecific hybridization, pachytene analysis, taxonomy, phytogeographical distribution, ancient literature, linguistics, etc., he established that the crop Pigeon Pea (*Cajanus*, Arhar, Tur) originated from certain species of *Atylosia* and was first domesticated in the Western Ghats. Similar studies on grain phaseoli (*Vigna*) indicated that urad, mung and matki also originated in India from wild relatives.

Professor De's group is presently working on various techniques for molecular genetic modifications of eukaryotes with the aid of protoplast fusion and liposome technology. The methods of recombinant DNA technology are being adapted for chemical dissection of plant genome as well as for preparation of receptor sites on chromosomes as targets for foreign DNA. The induction of variability of leguminous trees and latex-bearing plants through androgenetic haploidy and induced chimera has also been undertaken.

Professor De is associated with a number of scientific societies as member, founder or office-bearer. He has served several organizations of the government as well as some universities in various capacity. His research work has been supported by grants from ICAR, CSIR, DAE, ICMR, DST and NES. He has guided a number of research scholars.

ABRAR M. KHAN

Section of Agricultural Sciences

Prof. Abrar Mustafa Khan was born in 1918 at Bulandshehar in a family of prominent landlords of the district. After passing his Matriculation examination in 1936 from Government High School Bulandshehar, he joined Aligarh Muslim University, Aligarh wherefrom he passed his M.Sc. examination in Botany. During his student life he took active interest in Cricket and Tennis, and was awarded University Blues in both the games, a rare distinction during that period.

Soon after passing his M.Sc. examination, he joined research in Plant Pathology under the guidance of Dr. Rafeeq Ahmad Khan, Ph.D. (Cantab) the then Head of the Botany Department of the University. He was appointed a lecturer in Botany in 1943-44 and was later promoted to Professorship in the same department.

He proceeded to the U.S.A. in 1948 and joined the then Mecca of Plant Pathological research at the University of Minnesota. He was awarded the Ph.D. degree in 1950. His guide Prof. E. C. Stakman left an indelible impression on him.

Immediately after return from the U.S.A. he joined the Department of Botany at Aligarh and initiated research in the field of Plant Pthology. It was in the late fifties through fortuitous circumstances that he became interested in Plant Nematology, a field which hitherto was not given any importance in India. In this new venture he was greatly encouraged by Dr. F. J. W. Jones of Rothamsted Experimental Station (U. K.) and Dr. M. Oostenbrink of the Netherlands. Prof. Abrar, his colleagues and students in the department of Botany investigated the effect of organic manures for the control of diseases caused by nematodes, nematode-fungal complexes and certain other aspects. As a consequence of it, the Department of Botany has become one of the active centres of research in the field of Nematology in India. He has published more than 300 research papers in different fields.

It was through the initiative of Prof. Khan that the International Agriculture Centre the Netherlands, the Indian Council of Agricultural Research, New Delhi, and the Aligarh Muslim University agreed to provide training to Indian and Southeast Asian scientists in India as a result of which a large number of students from India and South Asian countries received training in the basic aspects of Nematology. He and some of the scientists from Indian Agricultural Research Institute, New Delhi, were instrumental in the formation of the Nematological Society of India in 1969.

Prof. Abrar has been a member/fellow of several learned societies including Indian National Science Academy.

He served as the first President of the Nematological Society of India and was also President of the Society for Advancement of Botany. He was the recipient of Rafi Ahmad Kidwai prize for the biennial 1968-69 and 1970-71.

He declined the Vice-Chancellorship of two Universities in order to retain his association with his favourite Subject of Botany in his almamater. At present he is serving as Professor Emeritus in the Department, the first teacher to be so honoured in the Faculty of Science of this University. □

S. B. SINGH

Section of Zoology

Born on August 30, 1932 in village Amnour of Saran District, Bihar, Prof. Shyam Bihari Singh took his B.Sc. degree from Lucknow University in 1950 and M.Sc. degree from Patna University in 1952. He obtained his Ph. D. degree from the University of Wales, Aberystwyth. While in U. K., he worked under the guidance of late Prof. T.A. Stephenson, F.R.S., Dr. T. B. Paole and Prof. B. M. Jones. Prof. Singh worked for short periods since 1952 in R. D. & D. J. College, Monghyr and Ranchi College, Ranchi before joining L. S. College, Muzaffarpur (Bihar University) in 1958. He became Reader and the Head of the Dept. of Zoology, L.S. College, Muzaffarpur in 1964. He joined Magadh University, Bodh Gaya as University Professor and the Head of the Dept. of Zoology in August, 1970.

Prof. Singh has travelled widely in U.K. and European countries. He has published 125 research papers and 15 students have obtained their Ph. D. under his supervision. His fields of interest are Entomology, Limnology and Ecology. He is associated with several learned societies. He is a Fellow of Zoological Society, London (F.Z.S.), Fellow of the Royal Entomological Society (F.R.E.S.), London, Fellow of the National Academy of Sciences, India (F.N.A.Sc.), Fellow of the Zoological Society of India (F.Z.S.I.), Fellow of the Academy of Zoology (F.A.Z.) and Founder Fellow of the Bihar Association for the advancement of Science & Technology. He was the Secretary General of the Zoological Society of India from 1976 to 1982. At present he is the Foreign Secretary of this Society. He is the Vice-President of the Indian Society of Environmental Biologists and of the Society for Science & Environment. He has actively participated in several national and international conferences, seminars and symposia. He has also chaired academic sessions on several such occasions.

Prof. Singh is actively engaged in research and more than a dozen students are carrying out research work under his able guidance. ☐

J. M. SENAPATI

Section of Physiology

Dr. J. M. Senapati was born on December 1928 at Cuttack, Orissa. He joined the Medical College at Cuttack as the first batch of students in 1944 and obtained M.B.B.S. degree in 1950. He worked as a Research Fellow of the Indian Council of Medical Research from 1951 to 1953 in the Physiology Department at Cuttack under the guidance of Prof. S. M. Banerji, Professor of Physiology and Prof. K. Subrahmanyam, Professor of Biochemistry. From 1954 to 1956 he worked as an Assistant Surgeon in the Community Development Project.

In 1957 Dr. Senapati joined as a Junior teacher in the Physiology Department of S. C. B. Medical College, Cuttack. He did his Postgraduation (M. D. Physiology) at All India Institute of Medical Sciences, New Delhi from 1959 to 1961 under Prof. B. K. Anand and Prof. A. S. Paintal. In 1961 he joined as Assistant Professor of Physiology at S. C. B. Medical College, Cuttack. During this period he improved the teaching and also worked on the problem "Mechanism of hyperpnoea in muscular exercise". He was promoted as Associate Professor of Physiology in 1966. He spent one year (1967) in the Laboratory of Prof. Julis H. Comroe (Cardiovascular Research Institute, University of California Medical Centre, San Francisco, U.S.A.) and woked on "Effect of exercise on respiration in trained, unanaesthetised dogs". He also spent much time in learning teaching methods and Pulmonary Function tests.

In 1970 Dr. Senapati joined as Professor of Physiology at M. K. C. G. Medical College, Berhampur. He devoted much of his time in improving the undergraduate and postgraduate teaching. With the help of his colleagues he introduced the system of teaching physiology which has a scientific basis and is clinically oriented too. He introduced recent techniques of nerve activity recording and established a neurophysiology laboratory with the help of Dr. Marcus Devanandan and Dr. Fahim. Dr. Senapati with colleagues Dr. Panda and Dr. Parida carried out research "On the role of muscle receptors in respiration" and made important contributions. Dr. Senapati visited the Patel Chest Institute from time to time and performed experiments using apparatus not available at Berhampur. Prof. Paintal was a great source of inspiration, help and guidance in his research activities. He has published several scientific papers in Indian and foreign Journals. He was invited for an Oration on Muscle receptors which was delivered in the Silver Jubilee Session of Anatomical Society of India at Lucknow in 1976.

On the basis of research work the National Academy of Medical Sciences conferred FAMS in 1983. Dr. Senapati is at present, Professor of Physiology at the S.C.B. Medical College, Cuttack. □

A. K. GHOSH

Section of Medical & Veterinary Sciences

Born in Beliachandy village, West Bengal on January the 10th, 1932, in a zamindar family, Dr. Ghosh passed Matriculation examination in the year 1947. He had his Medical graduation from Calcutta National Medical College in 1954 with brilliant results. He received the Master of Obstetrics and Gynaecology (M.O.) of Calcutta University in 1962 for his Pioneer works on Colpomicroscopy and vaginal cytology in the detection of early carcinoma of the cervix uteri, as a Research Fellow of the Indian Council of Medical Research. He got the membership of the Royal College of Obstetrician and Gynaecologist of London (M.R.C.O.G.), in 1963. Dr. Ghosh worked in different hospitals including teaching in one in England in early 60s. He joined National Medical College as Assistant Professor in 1963, became Associate Professor in 1966, Professor in 1976 and Head of the Department of Obstetrics and Gynaecology in 1982. He received Ph D of Calcutta University in 1973 for his works on "Significance of Bacteruria in Pregnancy".

In 1976, Dr. Ghosh was awarded the Fellowship of Royal College of Obstetrician and Gynaecologist, London. In appreciation of his merit he received a honorary Fellowship of the General Practitioner's Association in 1980 and a Gold Medal for Dr. Amar Pal Memorial oration Dr. Ghosh has devoted a great deal for both undergraduate, postgraduate teaching and patient care. Currently he is an extramural teacher of the University of Calcutta. A number of his students have under his guidance completed 'thesis' for M. D. examination and came out successfully. Recently he has published a 'Text book of Gynaecology' for the undergraduates. Dr. Ghosh is an examiner of undergraduate and postgraduate of different universities in India. As a research worker, his plunge in the field of reproductive biology, fetoplacental efficiency and fertility regulation are worth mentioning. In appreciation of his work he was awarded the Ford Foundation Fellowship in 1967 to work on hormone assay in Geneva. He also got PIEGO Fellowship from the United States of America in 1976 for advanced training in Fertility regulation including laparoscopy. His philanthropic works in the Calcutta slum area in collaboration with Mother Teresa's Missionaries of Charity since early 70's enabled him to study the 'Natural Family Planning by the Symptothermal Control', as a Collaborative Project of the Indian Council of Medical Research between 1978-80. He was invited in Mineapolis, USA to attend the World Congress of Natural

Family Planning in 1980. Professor Ghosh attended many national and international conferences, e.g. Moscow (1973), Edinburgh (1980) and represented scientific papers based on his Research works. Recently Dr. Ghosh has been invited to speak about the Calcutta experience of Natural Family Planning before the International Congress in Hongkong in November, 1983. Under his guidance the Calcutta National Medical College team is doing an excellent job in the National Priority sector of Family Planning. Nearly 5,000 laparoscopic tubectomy has been done in the rural West Bengal in a short period of time. In the field of infertility Dr. Ghosh's interest is evident from the successful use of Donor's semen in suitable cases.

Professor Ghosh's association with membership of the International bodies like East Calcutta Rotary, as Vice President, membership of the Society for International Development and International Fertility Research Programme are proof sure enough of his wide harizon. Travelling is the major hobby of Dr. Ghosh and he has been overseas many a time and visited several countries. □

P. G. ADYALKAR

Section of Geology & Geography

After his M.Sc. degree in Geology, Dr. P. G. Adyalkar has obtained the Ph.D. degree of Nagpur University on the 'Hydrogeology of Upland Alluvial Valleys of India'. He has obtained a Certificate in 'Hydrogeology' and training in 'Aerial Photography' from the Government of France in 1968-69. He was also a member of the Indian Delegation to Algeria in 1975 representing 'Groundwater'.

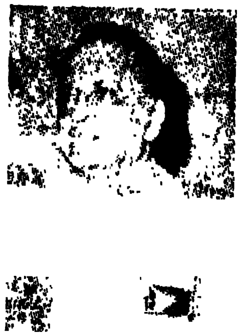
After discovering lead-antimony-sulphide ore near Bhiwapur in Nagpur district of Maharashtra, he joined the Geological Survey of India in October, 1953 as Assistant Geologist (Class II-Gazetted), serving that organisation till November, 1959 in the field of Economic Geology of Manganese, Copper and Lead-Zinc in Madhya Pradesh and Rajasthan followed by his work in Groundwater from June, 1957, when he was promoted to the post of Geologist (Jr.), Geological Survey of India.

From November, 1959 to November, 1966 he was on deputation to the Exploratory Tubewells Organisation in the Ministry of Agriculture, where he has worked in a Senior Capacity, guiding all hydrogeological work in relation to Exploratory Drilling and Assessment of Groundwater Potential in the whole country. On returning back to the Geological Survey of India in early 1967 he continued to work as Officer-in-Charge, Ground Water Division and from January, 1969 as Director of the Geological Survey of India in the Central Region upto March, 1979. There he was in-charge of all hydrogeological work in Maharashtra, Madhya Pradesh, Goa and Dadra & Nagar Haveli, and continued to be so even after joining the Central Ground Water Board in August, 1972. From 1979 till date he has worked as Director, Central Ground Water Board and in-charge of all hydrogeological work in West Bengal, Bihar, Orissa, Sikkim and Andaman & Nicobar Islands. He has served the Nagpur University as Member of the Board of Studies in Geology, Faculty of Science and Academic Council and also as Local Secretary of the 61st Session of the Indian Science Congress in January, 1974.

Apart from his pioneering work in the field of Economic Geology and Groundwater for about 30 years of active life, he has over 160 papers published in Indian and Foreign Journals of repute in the field of Economic Geology, Palaeogeography, Sedimentology, Palaeobotany, Prehistory and Hydrogeology. In the field of Hydrogeology he has covered practically all the espects, including Systematic Hydrogeology, Stratigraphical Hydrogeology, Groundwater Hydraulics, Hydrogeodynamics, Hydrogeochemistry and Hydrogeobotany.

He has delivered series of lectures in practically all the leading Institutions and Indian Institutes of Technology in Geology and Hydrogeology. For the first time he has identified large potential of groundwater in the Deccan Traps of Maharashtra, Madhya Pradesh and Dadra & Nagar Haveli, in the Laterites of Goa, Orissa, Bihar and West Bengal, in the Karsts of Madhya Pradesh, Maharashtra, Sikkim and Andaman Islands and in the Gondwana Rocks of Maharashtra, Madhya Pradesh, Orissa, West Bengal and Bihar, apart from giving guidelines for large potential of groundwater in Hard Rocks in the country, in which field he is a leading man in the country.

He is an active Member of the Indian Science Congress, serving it in various capacities from 1954 as Member of the Sectional Committee of Geology and Geography and later as Recorder for the years 1968-70 and now elected as President of the Section for the year 1983-84. Till today he is also a Member of the Committees on 'Science and its Social Relations' and 'Science and Economic Development, of the Indian Science Congress. He is a Founder Fellow of the Maharashtra Academy of Sciences (F.M.A.S.) elected in 1976, Fellow of the National Academy of Sciences, Allahabad (F. N. A. Sc.) elected in 1972, Fellow of the Indian Academy of Sciences, Bangalore (F. A. Sc.) elected in 1974, Fellow of the Institution of Engineers, India (F. I. E.) elected in 1978 and a Chartered Engineer (C. E.) from 1980. Presently he is the Co-Chairman of the Sub-Committee of Environmental Engineering of the West Bengal State Centre of the Institution of Engineers (India), Calcutta. □



M. K. DHAVALIKAR

Section of Anthropology & Archaeology

Dr. Madhukar Keshav Dhavalikar, M.A., Ph.D.; born 16th May 1930; educated Fergusson College and Deccan College Post-Graduate Research Institute, Poona; presently Professor of Archaeology, and Joint Director, Deccan College Post-Graduate Research Institute, Poona.

Carried out a number of archaeological excavations in different parts of the country noteworthy among which are Paunar (1966), Pandharpur (1967), Apegaon (1976) and Inamgaon (1968-83) all in Maharashtra; Kayatha (1968) in M.P.; Prabhas Patan (1972, 1975, 1976) in Gujarat; Hegadehalli (1972) in Karnatak. Deputed to Greece by Govt. of India in 1962 to participate in excavations at Pella; Alexander's capital in Macedonia.

Elected Secretary (Protohistory), Indian Archaeological Society, 1970-78; Vice-President, Indo-Greek Society, 1975-78; Visiting Fellow, Marathwada University, 1981; President, Maharashtra Itihasa Parishad (ancient period section), Bombay 1979;

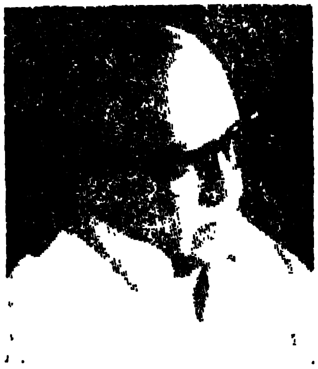
General President, Marathwada Itihasa Parishad, Parali Vajanath, 1982; President, Anthropology-Archaeology Section, Indian Science Congress, Ranchi, 1984.

Delivered the Ichalkaranjikar Lectures on "Life under the Vakatakas", Poona, 1968; Khareghat Memorial Lectures on "Maharashtra before the Marathas", Ratnagiri 1979; Dr. Ramesan Lectures on "Buddhist Art in the Deccan", Hyderabad, 1982.

Published over 100 research papers on Indian Archaeology and art journals of international repute and 12 monographs and books among which mention should be made of *Mathura Art in the Baroda Museum* (Baroda, 1971), *Ajanta—A Cultural Study,* (Poona, 1974), Indian Terracottas (Bombay, 1977); besides excavation reports on Paunar, Pandharpur, Kayatha and Apegaon. ☐

J. M. OJHA

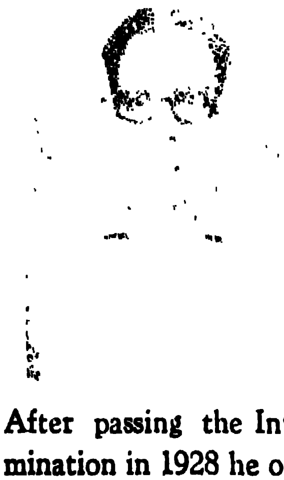
Section of Psychology & Educational Sciences



Dr. J. M. Ojha, born 1928, studied at Benares, Calcutta, Delhi and Baroda Universities. After spending sometime as a school counsellor, he started Manasayan—a consulting and distributing organisation for encouraging the use of psychological tests at a time when their use was expanding but availability was difficult. During this period he continued his academic activities and wrote a doctoral dissertation on the Revision (in Hindi) of the Differential Aptitude Tests which was later published as a book. The tests have been well received. In 1954, with some of his colleagues, he founded the journal, *Education and Psychology* which was later renamed as *Manas* and which is perhaps the only scientific journal in psychology published in India after the *Indian Journal of Psychology*—so old and still continuing.

In 1969, alongwith some of his professional colleagues, he founded BEHAVIOURAL SCIENCES CENTRE, an institution to encourage research activities in these areas, especially of interdisciplinary nature, and to publish materials related to this. The Centre was later registered as a Society and Dr. Ojha became its first Director and Secretary—an office which he also holds now. While continuing his professional and academic activities, he went to Honolulu, Hawaii, U.S.A. at the invitation of the East-West Center to participate in a seminar, 'Psychology in the changing society' in 1968. In 1974, he was invited to Vienna, Austria to participate in an UNESCO-sponsored seminar on 'Cultural Behaviour of Youth' organised by the International Institute of Music, Dance and Theatre in Audio-Visual Communication (IMDT) now known as the International Institute of Audio-Visual Communication for Cultural Development (Mediacult). His paper was later published as part of the book, 'Cultural Behaviour of Youth.' The Behavioural Sciences Centre, which he represented, was affiliated to Mediacult and Dr. Ojha was elected its Vice-President (one of the three), an office which he held for 8 years and at present he is a member of the Mediacult Executive Board. In 1977, Dr. Ojha was invited by the Canadian National Commission for UNESCO for an UNESCO-sponsored seminar, 'Cultural Pluralism and National Identity.' In 1981, for his contributions, he was awarded the Decoration, 'Austrian Cross of Honour in Science and Arts' presented by the Austrian Ambassador in India on behalf of the Austrian Federal President.

Dr. Ojha has written about 25 papers most of which have been in scientific journals. He has, on behalf of the Behavioural Sciences Centre, completed two studies jointly sponsored by the Mediacult and UNESCO : (1) Attitude of young people towards cultural institutions—a cross-cultural study covering several asian nationals, and (2) a 'Bibliography of literature on cultural and youth behaviour.' He has just completed an ICSSR project on preparing a documentation of literature on Inter-communal Behaviour, and is now directing a project on 'Mental health of working children,' sponsored by the Ministry of Social Welfare. He recently completed a study of Foreign tourists which is probably the first full-scale empirical study based on a large number of actual interviews to assess the tourists' satisfaction, aspirations and motives. His interests are psychological testing; social, organisational and, of late, cultural behaviour. □



B. MAITRA

Section of Engineering Sciences

Sri Bisweswar Maitra, President, Engineering Sciences Section of the 71st Session of the Indian Science Congress, was born in 1911. After passing the Intermediate Science Examination in 1928 he obtained the degree of Bachelor of Engineering of the Calcutta University in Civil Engineering in 1932.

After graduation he worked with some organisations as a Construction Engineer when he had an opportunity to be connected with the new Howrah Bridge.

He joined the Irrigation & Waterways Department, Government of West Bengal in 1938 as an Assistant Engineer and served in various capacities and finally rose to the position of Director, River Research Institute, West Bengal and Chief Engineer of the above Department. He retired in 1970.

Out of his entire service period with Govt. he served the River Research Institute as its Director for about 14 years. Before being appointed as its Director he visited various hydraulic Research Laboratories in India, Europe and the U.S.A.

After retirement from Government service he served the Irrigation & Waterways Department as its Adviser. After relinquishing the above post he served for sometime as Principal of the Regional Engineering College, Durgapur. He worked with a Consulting Engineering firm of International reputation as its Consultant for several years after relinquishing the post of the Principal.

During his service he was intimately connected with, important flood control works in North Bengal and Mayurakshi, Kansabati, Damodar Valley and Farakka Barrage Projects. While working with the consulting engineering firm he prepared among various schemes one for generation of power from tides.

He is a life Fellow of the Institution of Engineers (Ind.) & life member of both the Central Board of Irrigation & Power, New Delhi & Indian Society of Engineering Geology. He is a member of the International Association of the Hydraulic Research.

He is a member of the D. Phill. Committee in Engineering of the Calcutta University.

He has published about forty Research & other Technical papers and a monograph on 'Rivers of West Bengal.' □

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RANCHI is situated just south of the tropic of cancer and 85'30' E longitude and is 663 m above the sea level. Having a total area of 41 sq. km. and a population of about 5 lacs the city enjoys a salubrious weather being cool and pleasant all round the year. January is the coldest month, the average daily temperature ranging from maximum 23.2°C to minimum 9.7°C. Sprinkling of winter rains lowers down the temperature to 4°C on some days of late December and early January. Ranchi is well connected by road, train and airways. Boeing flights of Indian Airlines from Delhi and Calcutta touch Ranchi. Vayudoot flights from Jamshedpur, Rourkela and Calcutta are available for Ranchi. Direct express trains from Madras (Madras-Bokaro), Patna (Patna-Hatia), Calcutta (Howrah-Ranchi), are available daily. Northern parts of the country are connected by Hatia-Ranchi-Chandigarh-Kalka and Hatia-Amritsar Express. Travellers from Bombay and west can change at Rourkela or Jamshedpur to reach Ranchi and those from Delhi and Puri travelling by Nilachal Express will have to change at Muri and catch connecting trains to Ranchi. Other important railway stations around Ranchi are Tatanagar, Patratu, Chakradharpur, Dhanbad and Gaya. Road transportation is excellent, Ranchi is on National Highway No. 33 and Deluxe and Luxury buses are available to come here from all sides. There are regular bus services from Ranchi to almost all important places of Bihar and other states like West Bengal (Calcutta, Asansol, Durgapur and Siliguri), U.P. (Banaras), Orissa (Rourkela, Puri and Sambalpur) and M. P. (Bilashpur and Ambikapur).

Once famous as treasurehouse of diamonds attracting several expeditions in the past, Ranchi was the summer capital of Bihar till three decades back and was well known because of European and Indian Mental Hospitals, Headquarters of Eastern Command and A. G. Office of Bihar and Orissa.

The city of Ranchi has earned the distinction of being the heart of wide-ranging modern industrial complexes of national and international importance. Famous industries like Heavy Engineering Corporation (HEC) incorporating Heavy Machines and Tool Plant (HMTP), Heavy Machines Building Plant (HMBP), Foundry Forge Plant (FFP), Central Coalfields Limited (CCL), High Tension Insulator, Sri Ram Ball-Bearing and Waxpole Industries, etc. have come up during last 25 years. Ranchi is surrounded by other towns having important industries like TISCO, TELCO and Indian Tube at Jamshedpur ; Hindustan Copper Corporation at Ghatsila ; Indian Aluminium Company Ltd. at Lohardaga and Muri ; Bokaro Steel Company at Bokaro ; Bihar Alloy and Thermal Power Station at Patratu ; Usha Martin Wire Ropes Industry at Tati Silwai ; and Bharat Cooking Coal Ltd. (BCCL) at Dhanbad.

The city of Ranchi holds out an attractive amalgam of the best among tribals and other Indians and foreigners providing a cosmopolitan culture.

The forests of this area are dry tropical in nature. The two national parks one at Hazaribagh and the other at Bethla have become tourists' attraction because of their richness of wildlife like Chitals, Simbhars, Bisons, Wild-elephants, Tigers and Leopards. Places of tourists' attraction around Ranchi include Netarhat (famous for public school, sunrise and sunset, picnic spots, streams and falls), Rajrappa for its temples and scenic beauty, and waterfalls of Hudru, Jonha and Desham and many others.

Ranchi University

The University of Ranchi came into existence on 12th July 1960 with 10 Post-Graduate Departments, 1 constituent college and 20 affiliated colleges. Now the University has 8 Faculties, 21 Post-Graduate Departments, 3 Post-Graduate Centres, 82 Colleges (43 constituent and 39 affiliated colleges including 3 Medical and 2 Engineering) with about one lakh students on the roll.

The University of Ranchi which its territorial jurisdiction over the whole north and south Chotanagpur divisions (area 65000 sq. km., population 12 million) has unique distinction among the Universities of Bihar because of its location in the predominantly tribal area. Nature has been bountiful towards Chotanagpur where most of the mineral resources are concentrated. It also possesses most of the forest wealth of state. The city of Ranchi itself, the headquarters of the University has become the nucleus of heavy industries for the entire country. This unique location of the University brings in special obligations and responsibilities particularly towards the backward tribal population of this region. The University has also to cater to the needs of multi-lingual and a varied cross section of the population of the entire country. Consequently it has the unique privilege and obligation of playing an important role in the rapid development of Science and Technology in the State of Bihar for its economic betterment in tune with the ecology and environment.

Ranchi University has hosted a large number of national and international seminars, workhops and summer schools in Biology, Chemistry and Mathematics. The University has a well established computer centre, the only centre among Universities of Bihar. Establishment of University Leadership Project in Physics and Advanced Centre of Research in Anthropology has conferred well deserved importance on the Ranchi University.

Birla Institute of Technology, Mesra

Founded by the philanthropist, industrialist late B. M. Birla, the Birla Institute of Technology, Mesra (Ranchi) was established as an all India Institute of Engineering and Research by the Hindustan Charity Trust in July, 1955 and is an affiliated autonomous college of the Ranchi University. The institute is located about 15 km. away from Ranchi near village Mesra on the Ranchi-Patna highway in idyllic surroundings amidst woodland setting of sal trees on extensive grounds with the Swarnrekha river around the campus on the western, southern and eastern sides. The institute is residential and all members of the staff and students reside within the campus.

Birsa Agricultural University, Ranchi

Birsa Agricultural University with Faculties of Agriculture, Veterinry Science and Animal Husbandary and Forestry was formally inaugurated by Prime Minister Smt. Indira Gandhi on the 26th of June, 1981. It is the first of its kind established in the plateau region of Bihar which lies in the tribal belt of the Eastern Zone of our country. It was started with the primary objective of economic upliftment of Adivasis and other economically backward classes of Chotanagpur and Santhal Parganas through adoption of modern methods and technology of agriculture, animal husbandry and forestry practices while maintaining and preserving their traditional culture without losing their entity. Earlier the Agriculture and Veterinary Colleges were affiliated to Ranchi University. The University has been named after the great tribal hero and freedom fighter, popularly known as Bhagwan Birsa Munda and acclaimed by his people as Dharti Abba—Father of Earth. ☐

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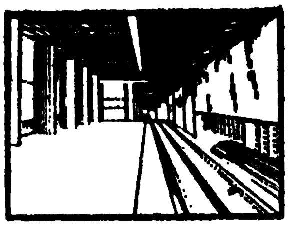

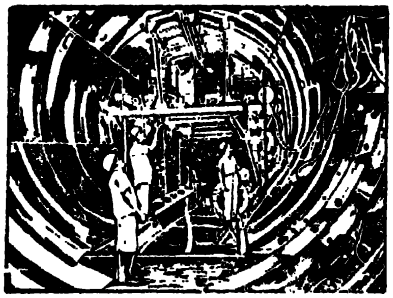

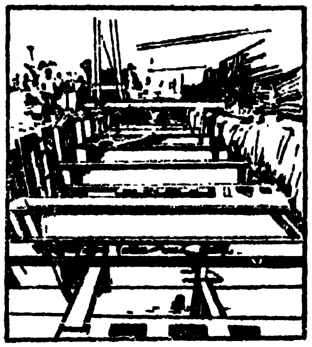

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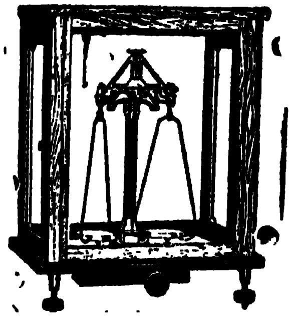

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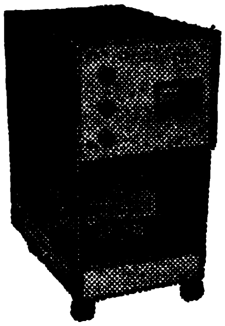

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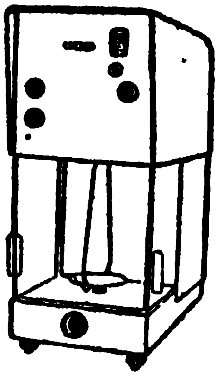

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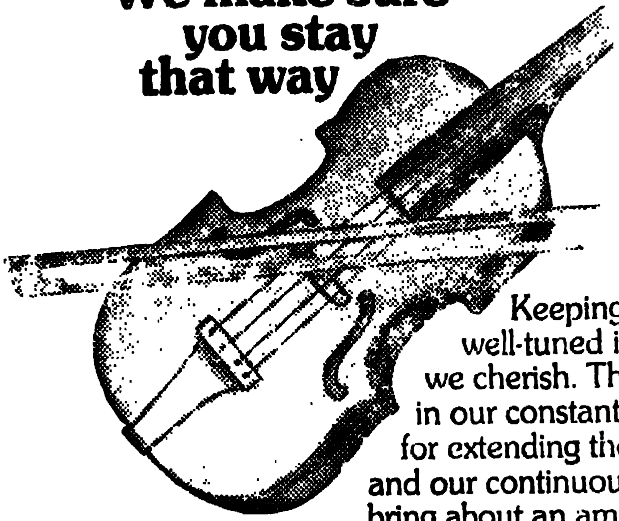

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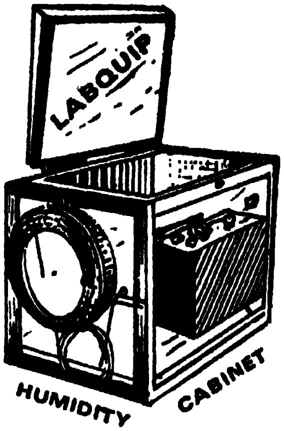

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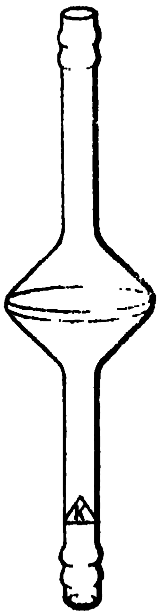

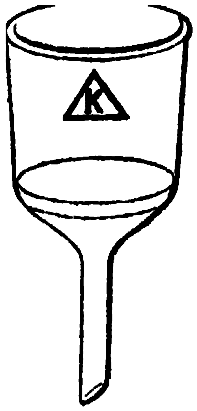

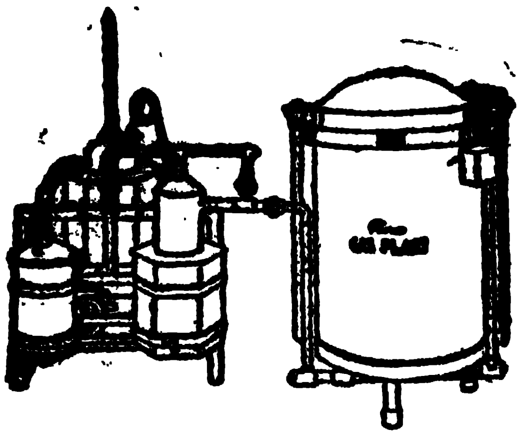

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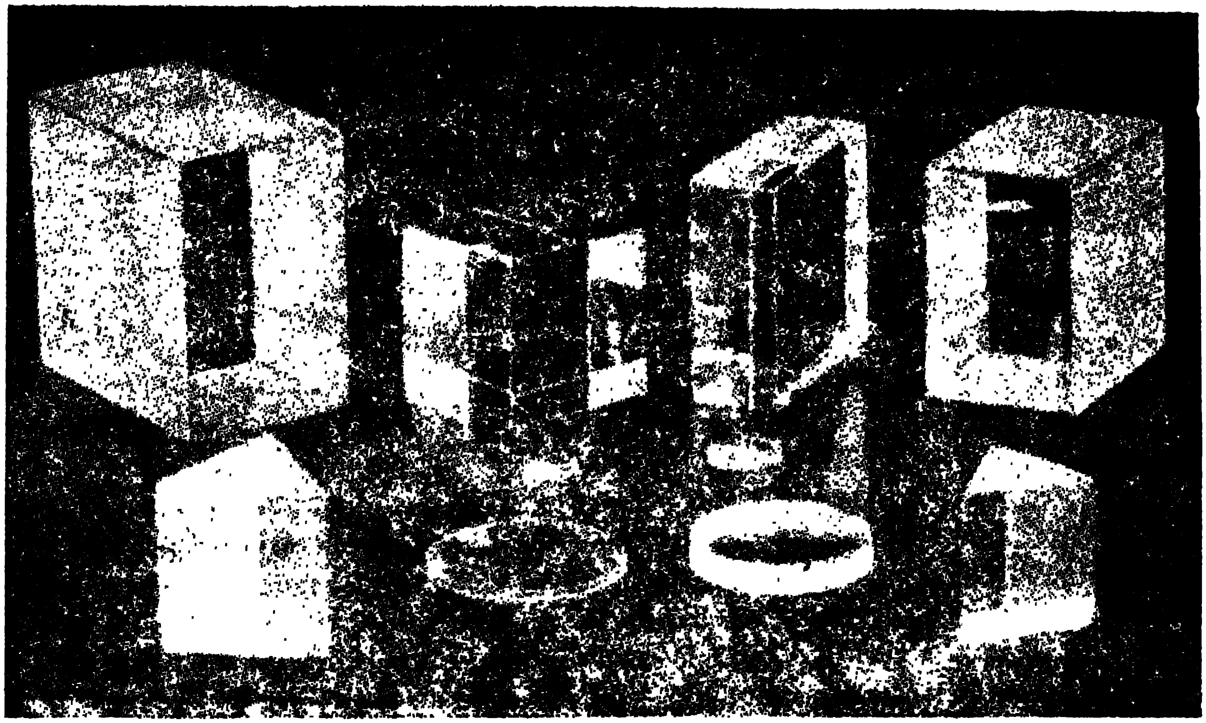

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(i) R. B. Walton and H. B. Woodruff, *F. Cl n. Insi.*, 82, 924, 1949.

(ii) W. C. Boyd, Fundamentals of Immunology, 1947, p. 123. (Interscience Publishers Inc., New York).

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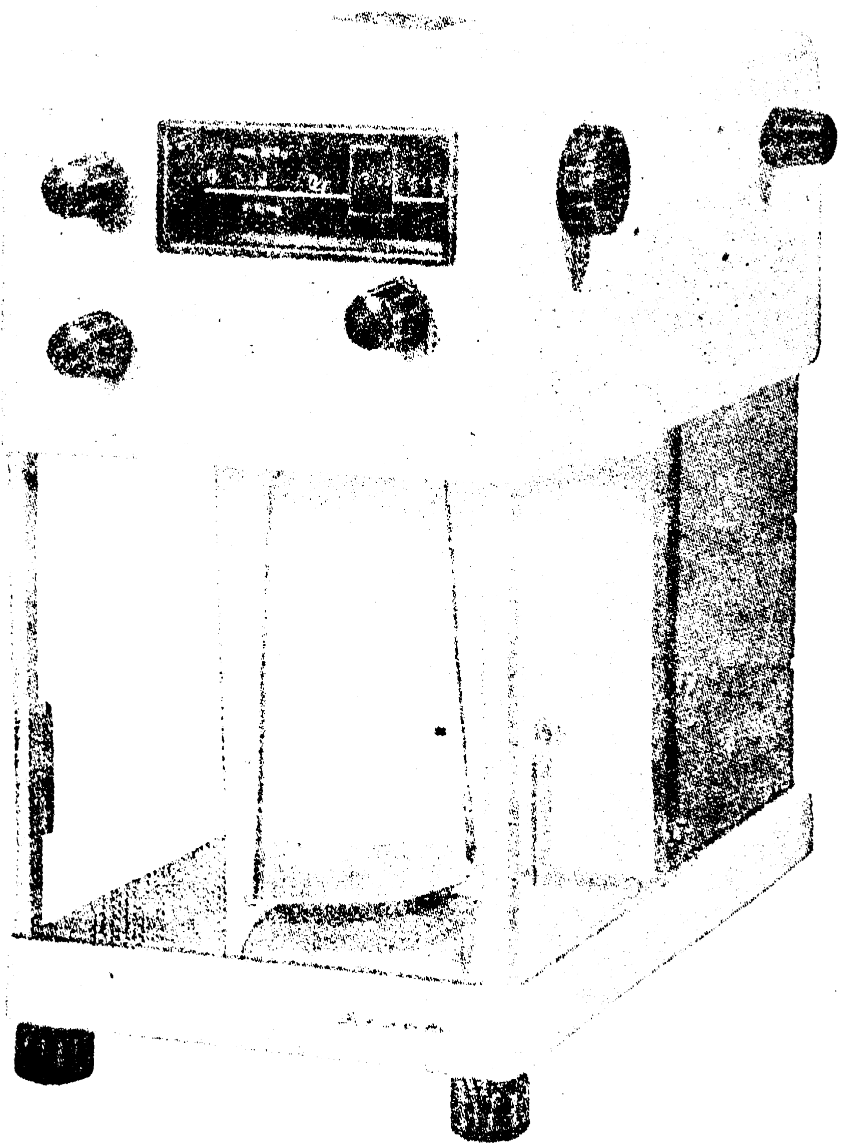

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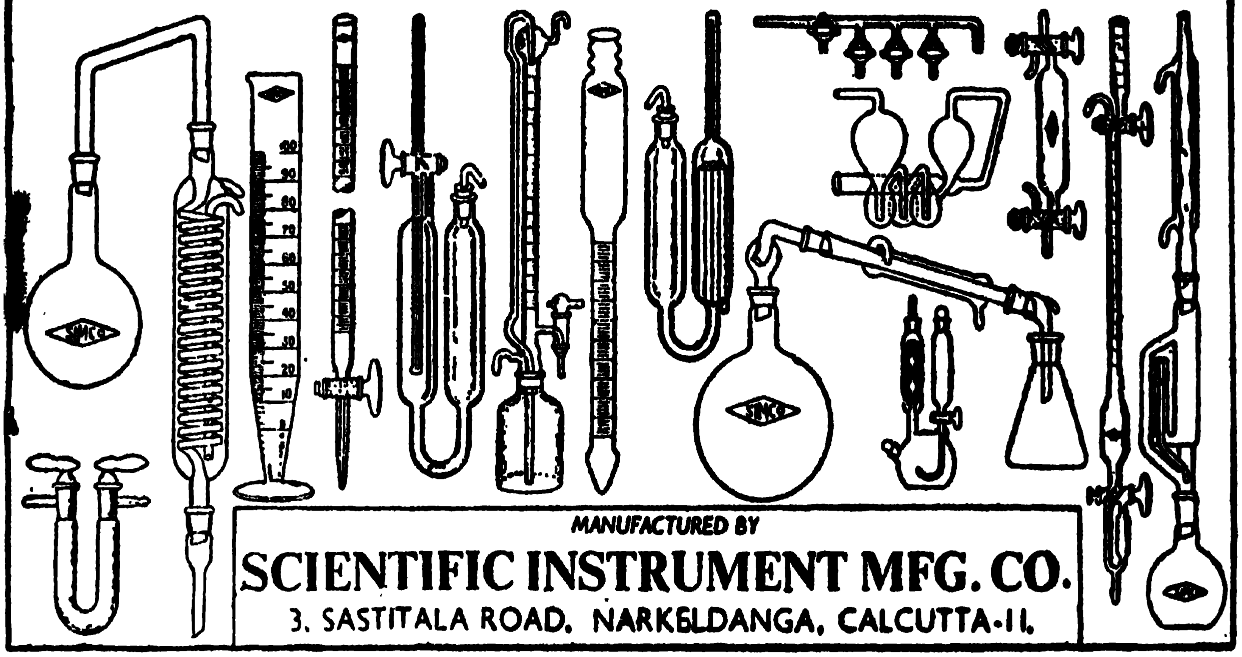

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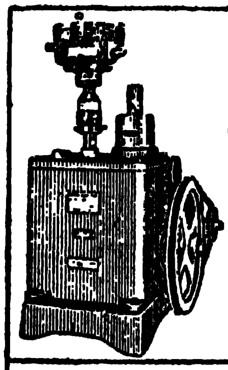

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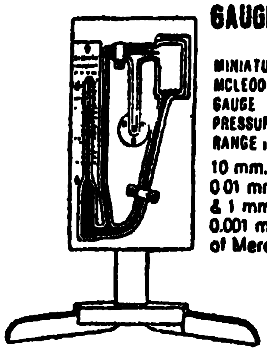

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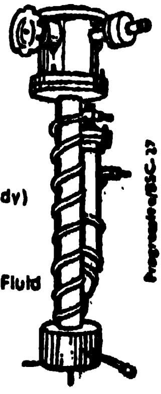

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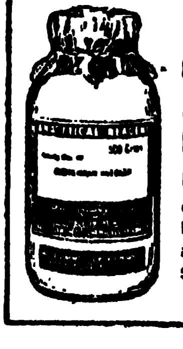

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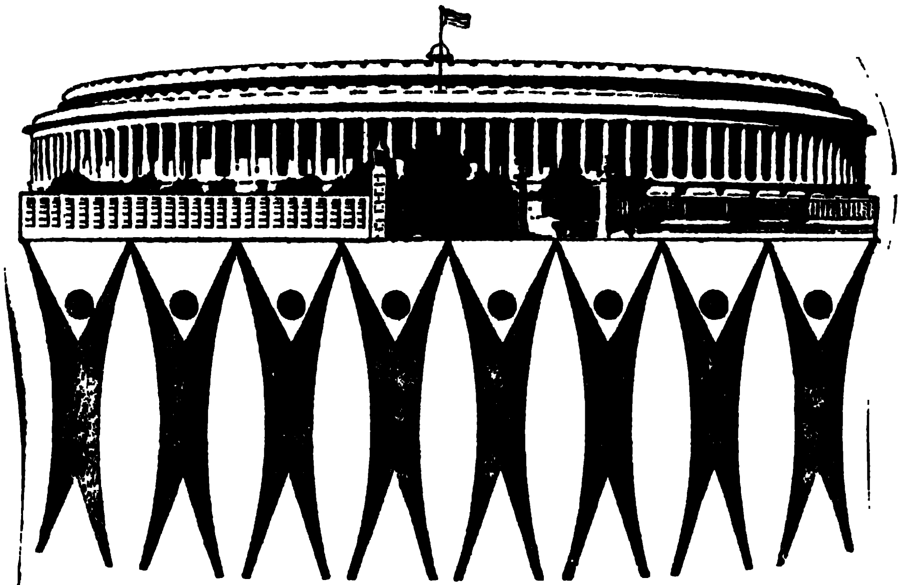

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SCIENCE & CULTURE

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QUALITY SCIENCE IN INDIA : ENDS AND MEANS

R. P. BAMBAH

[This is a condensed version of the Presidential Address given at the 71st session of Indian Science Congress at Ranchi 1984—Editors.]

THE focal theme, for this Session, is 'Quality Science in India—Ends and Means'. Although this focal theme was recommended by me in May 1982, before the Tirupati Session, it is a happy coincidence that many of the ideas and suggestions emanating from our discussions could form a suitable response to the Prime Minister's reliance on the Scientific Community for meeting the national goals for Science and Technology.

Before independence the country had a small number of leading scientists and groups of people working around them. However, one could not say the country had an adequate base of Science and Technology. As a result of the conscious decision by the freedom movement and the first National Government, headed by Jawahar Lal Nehru, that the welfare of our people lay in creating in the country a powerful base for Science and Technology, a few years before and more vigorously soon after the dawn of independence, various processes to achieve this objective were set into motion. A network of national Laboratories was set up, young people were identified for training in the leading institutions of the world, Institutes of Technology and Research Institutes were created, and a great programme of development of old and new universities was taken up. After more than thirty years of these efforts India has developed a respectable scientific base. But a time has come when one has to take stock and ask how we are going to use this base, to ask whether this base is adequate for the goals of the Society, which nourishes us, and to task what sort of priorities do we opt for and what sort of inputs and results do we plan for.

It is obvious that the quality of every human endeavour is closely related to the objectives of such an effort. No work can be considered to have high quality if it fails badly to achieve the objective it set out to attain. On the other hand any effort, howso-ever clumsy, that achieves its objectives cannot be dismissed as that of low quality.

Although it is difficult to draw hard and fast lines between various types of Science, it will be convenient for the purpose of defining their objectives to divide Science into four categories : I. Basic Science, II. Science for Development, III. Defence Science, and IV. Commercial Science. I shall take up these categories for further discussion in reverse order.

The objective of Commercial Science is to maximise profits by finding cheaper methods of production, more effective methods of marketing and distribution, or making it possible to manufacture new products which have a high potential for consumption. The appreciation of work in this direction is through patents, royalties, bonuses, or other fiscal rewards. However, in a developing country, where consumer products may be scarce, huge profits can be made by using borrowed or obsolete technology and the incentive for innovative work may be lacking. It may in the short run be quite profitable for an entrepeneur to buy or borrow technology which may be on the way out elsewhere, and use it here. Also,, the available resources could be monopolised for use in the manufacture of products that meet the demands of an affluent minority at the expense of the needs of the bulk of people, who are not that fortunate. It may, therefore, be imperative for the community to find methods by which the commercial sector could be made to participate in R and D effort meant for developing indigenous capacity for the production at economic costs of the products needed for the welfare of the people. Also, it may be necessary to make commercial sector participate in the development of the infrastructure and industrial climate needed for self-reliance. It may also be necessary to develop a Public Sector for long range research and productive efforts to create an appropriate Industrial Base. The effort in this direction is not to be measured in terms of profits, but in terms of its achieving its goals if self-sufficiency and creation of high level technology. The efforts of the Public Sector in India, therefore, should be assessed in terms of its achievement or non-achievement of producing the right type of indigenous capacity rather than monetary profits.

The objectives of Defence Science are again relatively clear—they are to help produce or adapt weapons and to devise means of communication, management and strategy to achieve maximum defence preparedness. The Quality of such an effort is measured in terms of how it helps to equip the Defence forces to meet possible hostile action. Although for a country like India the prospects of such a dilemma are rather remote, the Defence Scientists in more developed countries could face a crisis of conscience in that they may have to decide whether or not they should participate in the preparation of some weapons, whose potential for danger to the human, or other, species is very great. Perhaps it is time for the world community of Scientists to draw up a code under which Scientists of various nations could undertake not to take up work in certain areas of destructive Science. The whole world is living in great dread of a nuclear holocaust. It may be quixotic to hope for, but perhaps the scientists could come to a consensus that they will not do any further work on nuclear armaments.

When we come to science for Development we come in a sense to the most difficult area. Theoretically every advance in human knowledge has potential for application to development. However, when one is asking for funds for science for development needs, one has to fix well-defined short term as well as long term goals and every effort has to be evaluated in terms of those. Here Quality Science is a result oriented one. Although originality is always admirable, in the Science for Development emphasis has to be on the results. Here one can beg, borrow, buy, or imitate the work done elsewhere and adapt it to the solution of one's own problems. The work on Green revolution, that on Kalapakam reactor, the work that has gone into the ISRO programmes and that on nuclear energy are examples of Quality Science, although at the conceptual level at least one cannot claim much originality for it. Scientists working for development cannot afford to be complacent. Work has to be done on problems relevant to our needs. Ideas may be borrowed, but applications have to be need-based. Also, one has to be careful to achieve self-reliance. Otherwise one can find that one's programmes get into jeopardy at very crucial stages. One has also to be careful to distinguish between fashionable Science and meaningful Science.

A society that cares for science only for its utilitarian aspects misses the higher quality of life. Curiosity, love of beauty and urge to explore the uncharted demand aesthetically satisfying neat solutions, attacks on problems that have defied the great, search for insights that unify the diverse, and audacious new ideas that open up fresh vistas. They add lustre, beauty and a higher dimension to the achievements of human mind. These are the compulsions that make the great, pursue science for its own sake. This science is independent of time and space. It has universal standards and has to be judged by standards very different from those of utility or applicability. Here one cannot admire repetitive or second rate work. Here one demands aesthetic solutions, unifying concepts, besed on deep insight, and simplification of theories that can come only from deep understanding. This is the area in which old problems, unsolved for generations, stand as a challenge to the human mind. Pure Mathematics, Theoretical Physics, Astronomy and recent developments in Life Sciences are some of the areas where quality is to be judged by these exacting standards alone.

When Gerd Faltings recently made a major breakthrough on a 300 year old problem by proving the 60 years old Mordell conjecture, the report in Newsweek said : "Other than applications within Mathematics, the consequences of Falting's proof are hard to envision. Such an achievement in another Science could promise all sorts of spin-offs, as Einstein's relativity spawned atomic power and Crick and Watson's double helix bred genetic engineering. Falting's proof is an end in itself, an accomplishment that mathematicians liken to the four-minute mile. Falting showed it could be done, scoring a triumph for intellect". Every success like this is a tribute to the human spirit. When a problem, which had resisted the attempts by many great minds in the past over decades or even centuries, gets solved, the whole human race shares in the glory. One does not ask what applications it will have. When Physicists look for Grand Unification, they are not motivated by any spin-offs or applications. The reason is a search for aesthetically satisfying simple patterns to explain complicated phenomena. When a Ramanujan appears in a country one does not ask how utilitarian his work is.' One feels proud of the human intellect and is grateful to have something in common with him.

Although Science of this type does not know national boundaries, success in experimental side at least depends on the infrastructure of instrumentation, skills in maintaining sophisticated instruments, and in general the industrial base from which one can draw In such an endeavour a country like ours has to take stock of its capacity and choose problems for which resources could be provided and for which one could have a natural habitat, in which such work could be carried on at some advantage relative to better equipped Societies. The Kolar Gold Field experiment is a primary example of such an appropriate choice.

In the foregoing I have spelt out my ideas of the objectives of Science of various types. One can use these or other criteria to identify areas or problems worth studying However, there would not be much hope for successful pursuit if one did not have the physical and human resources needed for the purpose. Therefore, we would have to make a realistic appraisal of the present and potential resources that could be available. This may require the concentration of certain resources at certain selected places where they can be used to the greatest advantage. One may have to establish a culture of sharing in such a way that all scientists capable of using a scarce facility have reasonable access to it. Even in more developed economies, the establishment of institutions like Argonne National Laboratory or CERN have resulted from a need to share rare and complicated equipment. Various groups of active workers will have to do some hard thinking and evolve methods of development and sharing of precious resources. Experience of VEC or regional computer centres could be useful.

Even when one has identified the goals, fixed the priorities and made sure physical resources are available, real progress would be impossible unless one has the most crucial

resource, that is human talent. For progress, it is necessary that the country has vital human resources cansisting of great talent trained properly and motivated to undertake challenging tasks. In spite of the fact that our methods of training, employment and rewards are least suitable for attracting the young to a career in Science, and we have been able to reach only a small segment of our population, it is a fact that a great deal of scientific competence is available both in the country and among Indians working abroad.

A research student, who normally comes from a lower or a lower middle income group, is in no position to contribute to the family needs. Although some dedicated persons take up research studentships even at this handicap, the number of such people is small. Even among these the more enterprising take up Research/Teaching Assistantships in more affluent coutries like U.S.A. or Canada. The real brain drain occurs at this stage. From their stipends these people are able to contribute a sizable amount in terms of rupees to their family needs. Such scholars tend to stay on in the USA or Canada and provide a substantial support to their academic or scientific structures. The total effect is that our institutions are getting very few entrants of the right calibre. This is bound to badly affect the future of Science in our country and this is a problem that needs immediate attention. Unless we make the emoluments of Research Scholar comparable to those of entrants in other professions with similar levels of achievement and age, and make sure their conditions of service stay comparable, any steps taken to improve standards of scientific endeavour will, I am afraid, turn out to be largely futile.

For development and utilisation talent for scientific work, the obvious areas of concern are (i) Identification, (ii) Training and Motivation, (iii) Induction into the Scientific Manpower, and (iv) Maximal utilisation

Under the general principle that every gifted student has the right to a challenging education, which will not underestimate his potential, the standards of work and expectation at these institutions will be kept very high both for the students and the teachers. As is well known, a student reacts very strongly to the attitudes and capacities of his peer group. One hopes that under the influence of their peers, all equally gifted, these students will be ready for training at its most excellent. Although healthy competition is desirable, it is a sad fact that the more accomplished of our Indian citizens find it difficult to work together. It is perhaps a consequence of our examination system where too much emphasis is placed on relative rank and marks. An essential feature of the high level pace setting schools would be development of group activities and group endeavour, whereby one learns to work as a member of a team to achieve the highest potential of the group, as distinct from the individual. Since excellence is the sole motivation, there is no room for any reservations in these schools for the gifted.

At the end of the Higher Secondary stage, through various processes of search and selection, an adequate number of gifted students in each state will be identified for intensive and demanding training at the University level.

At the moment I would only like to point out that the type of education that the gifted are entitled to and the country needs will be extremely hard to provide in the existing institutions. Our experience of starting new universities for excellence has also been not too happy. In order to learn from our mistakes it would be useful to take stock of some of these.

The gifted have a right to interaction with best scholars who are actively engaged in creative work. The Faculty should be in the prime of their productive period. It is a sad fact that really creative life of an individual has a limited span, and we have to take account of this.

To take care of the university level training for the gifted I would like to suggest the following steps :

(1) We should identify some of the existing institutions where adequate physical facilities like buildings, laboratories, and libraries, etc., are available. These should be taken over at the national level for use for first rate training for the gifted.

(2) The faculty should be drawn from the total university system on a tenure basis keeping the following principles in view :

(a) The faculty should consist of creative people at the peak of their creative powers, so that the bulk, say 70 per cent at least, should be in the age group 30 to 45.

(b) No person will stay in an institution of this type for more than five years at a time, maximum number of times one could come to such an institution being two.

(c) Twenty per cent of the Faculty will leave the institution every year to be replaced by fresh entrants. Those who leave would revert to the general cadre, and in exceptional cases, be sent to another selected school

(d) Adequate arrangements for housing, and compensation, in addition to the prestige and excitement of working in such a university, will be provided because of the adjustments that have to be made in one's pattern of family life and general living and working, especially for the experimental scientist.

(e) People who win awards like Bhatnagar medal, Younger Scientists' awards of INSA, ISCA, medals of the Indian National Science Academy, and Hari Om Trust, etc. will be expected to work on the faculties of these institutes for some time as a condition of the award.

(3) For academic and administrative decisions compact committees of experts, with 25 per cent retiring every year, should replace the cumbersome machinery of Senates, Syndicates, etc. These committees should be authorised to take final decisions on matters falling within their competence.

(4) I should be desirable that no student takes two consecutive degrees from a single such institution.

I have given a bare sketch which could be filled in : the principal objective, being a constantly renewing faculty at the peak of its creativeness and exacting standards of work from the faculty as well as the students.

If the gifted are identified and trained properly, it is natural that all professions requiring leadership qualities would like to have their proper share. For the scientific work, in order that we also have an adequate share, not only should we bring out the excitement and challenge of Science during the training of our students, but the Society, as a whole, should also acknowledge its need for skilled scientific manpower by making the Scientific career as attractive in material terms as any other. Although some highly dedicated and motivated people will come to the profession, no matter what material terms are offered, the bulk of the scientific endeavour of every society depends on a large number of competent people, who could do equally well in various professions, and it is important that suitable incentives are provided to attract them.

After we have inducted the right type of people, we may still fail to make full use of their potential unless an ethos of cooperative endeavour at highest level has been built up. One would, of course, need equipment, office space, housing, etc. But more than that there should be a clear realisation that in a Scientific community people of different age groups, experience, skills and capacity have to complement each others' efforts. If this is recognised one could work out suitable administrative mechanism and ways of giving recognition to all the members of a team—the old ones, who are perhaps best equipped to set goals, identify problems, suggest methods, get the necessary equipment and the younger one, who can provide hard work and fresh ideas and are better able to learn new techniques and absorb new ideas. When a breakthrough occurs it should be clear that it could come through because of the total effort of all the individuals involved and not because of the eminence of one person or the brilliance of another.

I have dwelt in detail on the identification, training, induction and use of the scientific talent with an emphasis on the role of special institutions for the gifted. For the immediate future the creation of such universities appears to be imperative. However, they will not survive as centres of excellence and will tend to regress to mediocrity if the general university system is allowed to drift.

"The first Indian universities were established more than 100 years ago in imitation of the London University, as it then was. They all began as purely examining bodies and continued to be so for quite some time. Most of the present universities inherited their structure and governance from these universities and have not been able to adapt to the present needs of seeking and cultivating new knowledge, of engaging vigorously and fearlessly in the pursuit of truth, of identifying gifted youth and helping them develop their potential to the full". "The so-called autonomy of the universities is no real autonomy. The object of autonomy in the universities is to make it possible for its members to have a free flow of ideas and to engage in the pursuit of truth free from pressures from the establishment to whom these ideas may appear dangerous. The object is to enable to universities to serve as the 'conscience of the Nation', 'as a forum for the critical assessment of Society'. In our system there is no such possibility. The only effect of this sham autonomy is to give powers, without accountability, to the politicians, posing as teachers, and to executive officers without any ideals. Also, under immediate pressures the freedom to take decisions by the University officers and executive bodies, who in the present set up rarely reflected the best academic traditions, has led to many wrong decisions on almost all aspect of the University life—admissions, training, examinations, recruitment, promotions, etc I think it is time to take stock of the ethos in the University systems and try, to evolve a new set up free of the present unwieldy, expensive and useless structure.

It has been repeatedly pointed out that our system is examination dominated. If one analyses it carefully one finds that the whole system is geared to the determination that large segments of the student body are more mediocre than others. Instead of going through the ritual of holding final examinations, for a student, leaving the educational process, it is enough that the institution, where he has studied, gives a certificate indicating the courses he has attended and his performance in the examinations conducted internally by his teachers. For a job outside or admission to a higher course, the employer or the new institution can give its own test to dertermine a candidate's suitability for the job or the course he is applying for. In those cases where numbers seeking admission are large, objective type papers, testing only the level of the information acquired by the candidates, can be used to sift a smaller number, who could then be given a more comprehensive test. Since various objective type papers could be distributed to the candidates at random and marked mechanically by computers, or even human agents, in a very short time interval, chances of cheating and other malpractices can be reduced. Since the educational process will not be involved in certifying a large number of candidates for degrees, the huge superstructure of Boards of Examinations, Controllers of Examinations, Secrecy Sections and what not could be dispensed with and the energy released thereby could be used for more worthwhile pursuits.

Regarding the structure of the Universities, we should seriously give consideration to an All India University Service, insulated from the Government through a Commission like the UGC, or the UPSC, forming a common pool of academics and academic administrators at the national level This pool could be used to supply the system so that each institution has both continuity and continuous change, a certain proportion of people being changed every year. This would avoid inbreeding as well as our tendency to fall into a rut or divide into factions. The actual academic and administrative decisions would also be taken by compact committees of competent people, a fixed proportion of whose membership is changed every year. The system will have academic autonomy so that academic decisions are taken by the people engaged in teaching and research themselves. It could have financial autonomy, if funds are allocated on a long term basis and released periodically, without the Vice-Chancellors having to knock at the doors of the Finance Ministries every few months.

A working group on Universities could fill in various details and look at various alternatives. The Education Commission report is full of rich suggestions. The principal objective should be to evolve a system which would free our universities from mediocrity, parochialism, inbreeding, groupism, politicalisation in the worst sense of our teachers, and tyrannies of small Caesers. Also the system should gather the strength to tell the students that it is their right to get good education and it is the responsibility of the system to provide it to them. A federal system, managed by the best of the academics, with a mechanism for continuity and continual change is needed. The system could also be provided with a mechanism to get people from different regions, communities and backgrounds, to work together in the academic process without giving them an opportunity to divide into factions. This would strongly support the goal of National Integration. This may also help realise the objective laid down in the Education Commission report of "concentrating scarce human resources to bring together in face to face intellectual communion of goodly number of persons of high potentialities who by their contact, dialogue and communication, stimulate each other to put forth their best creative efforts". It will also enable the excellence generated in a selected number of universities to gradually spread to others, both because Faculty members will be continuously moving from the selected institutions to the general system and back, and because the students trained in the few universities for the gifted will eventually become available for participation in the general system. Since these people will have been selected by national processes, the ills resulting from narrow parochialism will be reduced. ☐

FORTIFICATION—A POTENTIAL WEAPON TO COMBAT MALNUTRITION

B. M. CHAUHAN and A. C. KAPOOR[1]

Distribution of vital nutrients among our masses through fortification of commonly consumed foodstuffs does not involve any elaborate nutrition education or change in the stubborn dietary habits and the process brings about no increase in cost. Under the existing low level of literacy, low per capita income, established cereal-based food habits and prevailing other socio-economic conditions, fortification can be regarded as an effective measure of improving the nutrition of our people.

AT the present level of our knowledge, it is possible to state with accuracy the essentiality and multitude of nutrients in human nutrition. It is well established that a permanent solution to the nutrient problem lies in the increased production and consumption of foodstuffs supplying all the essential nutrients. In the context of existing conditions in India with regard to levels of protective food production and economic status of the population, it is necessary to consider the alternative proposal of augmenting nutrient intake by the addition of important nutrients to the foods generally consumed by the people.

Fortification and enrichment are the terms used to indicate the addition of dietary essentials to foods. Fortification of a foodstuff implies the addition to a food of one or more dietary essentials in amounts which make the total content larger than that found in the particular food in its natural state. On the other hand, the term enrichment signifies the addition of essential nutrients to the foodstuffs in order to restore the losses occurred in their contents during processing.

For making fortification and enrichment programmes viable, certain conditions are necessary to be examined. Foods chosen for fortification should be consumed by a fairly large segment of population. The choice of nutrients to be incorporated should be determined by the commonest nutritional deficiencies observed in the population. It is also essential that technology of addition of the nutrient to the food should not cause more than an insignificant rise in the cost of processed foodstuff. The cereals, wheat and rice, common salt, sugar and tea are some of the commonest foods consumed by the population both in rural and urban areas and hence lend themselves as ideal vehicles for fortification. Nutritional contribution by the fortification of other foods e.g. milk, bread, vanaspati, fruit products, sago etc. may be marginal in magnitude but cannot be afforded to be completely overlooked.

Fortification of Salt

Because of its easy availability, small but inavoidable requirements, and relative inexpensiveness, salt is perhaps the most suitable carrier through which additional food nutrients may be administered efficiently.

Iron deficiency anaemia is one of the major nutritional problems in our country[1]. Therefore, there is a regular need forfortifying food with iron, and salt is perhaps the most appropriate vehicle for this fortification. Ferrous sulphate is the most suitable salt from availability and cost point of view but it is unstable and develops colour. Ferric-salts are stable and do not develop colour but absorption is low. It has been found that ferric orthophosphate alongwith absorption promoter, sodium acid sulphate, has better keeping quality. Based on the current prices, it would appear that increase in cost per kg of fortified salt will vary from 8 paise to 17 paise.

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The iron fortified salt suggested by National Institute of Nutrition has the following formula :

Common salt	1 kg
Ferric orthophosphate	3.5 g
Sodium acid sulphate	5 g

This mix contained 1 mg of elemental iron per gram and when added to diet, iron from the mix was absorbed to the extent of 5%.

The goitre, the unsightly but unhidable manifestation of iodine deficiency affects life long the helpless masses in sub-Himalayan regions and parts of the adjoining plains. The incidence in the region of endemicity has been found to be as high as 40% in some studies[2]. The regions where air, water, soil and foodstuffs grown are poor in iodine are traditionally the areas of endemic goitre. To overcome this problem salt is iodised. On account of its stability potassium iodate is preferred to potassium iodide for the iodisation of the crude moist salt consumed. Usually, iodised salt contains 40 micrograms of iodine/g salt. The iodine prophylaxis has resulted in the reduced incidene of goitre. In some hilly states, the consumption of iodised salt has been made compulsory.

The calcium is very important for the growth of children. The calcium present in cereal-based diet is not fully available as phytic acid present in cereals combines with calcium and forms a calcium phytate complex which is unavailable to the body. Therefore, it needs to be provided additionally. Fortifying salt with calcium sulphate at 5% level will provide about 100 mg of additional calcium per 6-8 g salt normally consumed by a child per day or about 200 mg of calcium to adult per 16 g of salt normally consumed per day. This along with other source of calcium in the diet will meet the nutritional requirement of this element.

Indian diet is also deficient in some important vitamins such as vitamin A, thiamine, riboflavin, pyridoxine, niacin and ascorbic acid. The salt can be nutrified with a premix containing these vitamins. The vitamins nutrified crystal salt is employed by some bakers for nutrification of bread, buns and other bakery products. Such salt is also used for snack topping (potato chips) to provide supplementary vitamins[3].

Fortification of Cereals and Cereal Products

Since time immemorial cereal grains have provided the basic substance for mankind. Today they still represent the world's major calorie and protein sources in the developing countries. Unfortunately, cereals have some nutritional shortcomings, particularly as protoin source. Cereals are inferior in quantity and to other sources of protein. It has been found that addition of limiting amino acids could dramatically increase the amounts of usable protein. By the addition of lysine to wheat, lysine and threonine to rice, and lysine and tryptophan to maize the protein quality of these cereals increase considerably without increasing the volume of the food[4].

Cereals are also deficient in vitamin A, thiamine, riboflavin, niacin, pyridoxine, folacin, iron and calcium. The nutrification of cereals with these nutrients has been carried out successfully in some countries[5]. In developing countries where these vitamins and minerals are deficient in diets, fortification of cereals with them will go a long way in combating the malnutrition.

Rice is a staple food for a large segment of Indian population. But like other cereals it is deficient in some of the essential nutrients. Keeping this point in view, the rice kernels are impregnated with vitamins[6]. These kernels are then coated with a rinse-resistant material. The premix kernels are blended at local rice mill with ordinary white rice in the ratio of 1 : 199 to produce enriched rice. The nutrification involves addition of vitamin A, pyridoxine, folic acid, vitamin E and thiamine. This is an effective and practical method of improving the quality of rice where it is invariably washed before cooking. However, with any nutrified rice product, excess water should not be used in cooking as water poured off after cooking will mean some losses of nutrients.

In December, 1967, fortification of white bread with lysine, vitamin A, thiamine, riboflavin, niacin and iron was instituted in the Modern Bakeries, a Government of India Enterprise. Vitamin A is provided at a level of 8,000 IU per kg of bread made from both dark and light wheat flour. Modern Bakeries alone are producing nearly one hundred million loaves of bread per year. In some countries, potassium iodate is added at 2 ppm (dry wt) to all the bread made. This helps in reduction of incidence of goitre particularly in hilly areas.

In India, bulk of the indigenous wheat moves from farm to market without going through any sort of silo or bulk storage and a considerable amount of wheat is milled in central mills where nutrients can be added. As a result of this "Paushtik Atta" with addition of 5% or 10% groundnut flour has been introduced as an item of production in the roller flour mills. In addition, the "Atta" is also fortified with vitamin A, riboflavin, thiamine, niacin, calcium and iron.

Fortification of Oils and Fats

Oils and fats are important dietary ingredients, although their consumption varies with the economic strata of the people. Oils and fats are good carriers for those nutrients which are soluble in them. In India the *Vanaspati* or hydrogenated oil is being commercially fortified with Vitamins A and D at the level of 25 IU and 2 IU/g, respectively. The hydrogenated oils are also fortified with 5% sesame oil to provide sufficient quantity of polyunsaturated fatty acids.

Fortification of Milk

Milk is of special significance in infant diets and makes contribution to the nutrition of adults as well. But cow's milk is not a complete food for the nourishment of an infant or young child. It is not sufficient in vitamin D, iron vitamin C, vitamin B6 and vitamin A.

Nutritional authorities have generally endorsed milk as logical food for fortification with vitamin D. It provides both calcium and phosphorus that must be present with vitamin D for normal calcification of bones and teeth. It is also a major food for infants and the developing child for whom the need for supplementation of the diet with this vitamin apparently is the greatest[7]. The decline in the incidence of rickets in recent decades in USA has been credited in large part to the fortification of cow's milk with vitamin D.

When fat is removed from whole fluid milk all fat-soluble vitamins including vitamin A are also removed. The resulting skim milk can serve as a vehicle for fortifying with fat soluble vitamins. Skim milk or low fat liquid or dry milk products should have vitamin A added and, if given to infants, should probably have vitamins D, E and C added as well. The techniques for fortification of skim milk powder are available.

In the normal diet of the people in developed countries milk and milk products provide around 20% of the daily requirements of vitamin A or roughly 700-800 IU of the vitamin A per day. In India the average per capita consumption of milk being only 150 ml the availability of vitamin A from milk comes to around 100 IU. To raise this contribution to a certain extenf four Mother Dairies in India at New Delhi, Bombay, Madras and Calcutta have undertaken the fortification of milk with vitamin A. About one lakh litres of milk to be marketted daily by each of these dairies is being fortified to a level of 2000 IU of vitamin A per litre of milk. This provides the average consumer of milk in the city nearly 450 IU of vitamin A. The project is being implemented through National Dairy Development Board and involves very reasonable expenditure of 0.137 paise per litre of fortified milk.

As regards the fortification of milk with iron, the reports indicate that ferrous sulphate has metalic taste and may activate some of the enzyme systems in milk. Ferrous ammonium citrate is, therefore, the choice for fortification of milk and milk products. This does not alter the appearance and flavour of milk materially. Ten mg of iron are generally added to one litre of milk.

Fortification of Fruit Products

Fruits in addition to supplying vitamin C, betacarotene, and a small amount of B-vitamins, are unique in providing considerable quantity of potassium and very small amount of sodium. Application of technology has now introduced several fruit products e.g. canned fruits and fruit juices, fruit drinks, fruit preserves etc. in our dietary.

Fresh fruits for obvious reasons are not suitable vehicles for fortification. Fruit juices and drinks are the primary fruit products which are being fortified these days[8]. Frozen fruits in developing countries are often enriched with ascorbic acid but usually the primary purpose is not nutritional but to prevent the undesirable browning reactions and off flavour development.

By now the most common nutrient used for fortification of fruit products is vitamin C and to a lesser extent vitamin A. The later is added in the form of beta-carotene which imparts colour also. A few juices such as grape juice and drinks, frozen fruit drink concentrates, fruit beverage powders and fruit squashes are also fortified with B vitamins. Fruit products, however, cannot be fortified indiscriminately because fruit products in India are controlled by Fruit Product Order Standards.

The ascorbic acid fortification of fruit juices and drinks has a sound nutritional basis and therefore, has become accepted as a common practice. Products from fruits with a low natural ascorbic acid content benefit most by the addition. Such fruits include apples, apricots, bananas, peaches, pears and plums. Certain varieties of cherries, litchi and pineapple with intermediate levels of ascorbic acid can also benefit. By doing so there has not only been the protection of flavour and colour, but there has been a considerable improvement in the nutritional value also.

Some fruits supply considerable amount of provitamin A also. Peaches, apricots and mangoes are the richest sources which is also indicated by their deep yellow to orange colour. Fruit products can also be fortified with beta-carotene or vitamin A palmitate and this can supply significant quantities of this vitamin A in the diet of our people depending upon their dietary habits. With proper processing, beta-carotene is stable in fruit juices and drinks. In the case of fruit products which are not naturally yellow or orange coloured e.g. apple, grape etc or where no additional colour is required, commercial forms of vitamin A are available which are adapted for use in water-based fruit products.

Although fruits are not considered good sources of various B-vitamins, they do supply small amounts of these vitamins and thus make a contribution to our overall dietary intake of these nutrients. The fortification of fruit juices and drinks with B-vitamins has not been so widely practised as ascorbic acid and vitamin A. Grape and grape-apple blend fruit drinks fortified with thiamine and riboflavin have been commercialized. There is no stability problem associated with the vitamins in these fruit drinks. B-vitamins have also been used to enrich various frozen drink concentrates and beverage powders without difficulty.

Fortification of Sugar

Consumption of sugar has increased more rapidly than any other food commodity, especially in less developed countries. Sugar is one of the several food items which are consumed on regular basis over the seasons of the year by the entire population of a country. The sugar (sucrose) generally eaten by the mankind is so highly refined that it contains nothing but calories. When sugar is eaten, it forces out of diet other foods and these foods always contain more proteins, minerals and vitamins than sugar. In other words an inclusion of sugar causes an overall decrease in the nutritional quality of man's diet. It is now economically and practically feasible to fortify sugar[9] with some vitamins and minerals and raise its nutritional quality.

Vitamin fortification of sugar with thiamine and niacin is especially advisable as it makes sugar metabolically selfsufficient. Consideration should be given to the fortification of sugar and sugar rich food products with phosphates to combat the development of dental decay which pure sugar promotes.

Nutrification of sugar[10] with vitamin A is being commercially practiced in Guatemala, Pannama, Costa Rica and other Central American countries. The chosen amount of vitamin A to be added to sugar provides the Recommended Daily Allowances for an adult if one consumes average quantity of sugar revealed by a survey. Vitamin A palmitate, a pale yellow product has been selected for incorporating in sugar. In the process of fortification a vitamin A sugar premix is first prepared and, then added in a set ratio, to the flow of sugar. This followed by adequate mixing to ensure uniformity of the final vitamin A fortified product. Fortified sugar containing upto 50 IU of vitamin per g does not exhibit any colour or flavour problems when consumed in hot coffee, tea, or orange, pineapple and lemon beverages and other food products.

Fortification of Tea

Tea is widely consumed in some parts of the world. Survey on food consumption pattern and consumer habits in India has revealed that tea is consumed by young and old, rich and poor, in both rural and urban areas and thereby lends itselt as a vehicle for fortification. The idea of using tea as a vehicle for providing meaningful quantities of vitamin A to an entire population was conceived at the New Delhi Mission of the Agency for International Development as early as 1967.

Tea dust is fortified by dry mixing the dust with fine powdered vitamin A palmitate[11]. Tea dust, so nutrified retains about 85% of vitamin A activity after storage for one year at room temperature. Fortification of tea leaves needs different method. Emulsions made by homogenizing vitamin A ester with thick acacia or dextrin solutions, are sprayed, on to the leaves, When emulsions were diluted with sucrose solution and sprayed on leaves, the fortified vitamin A showed satisfactory stability. Trials indicate that vitamin A palmitate applied in both the powdered form to the dust and the emulsion form sprayed into the leaves retain 100% vitamin A activity even after one hour of boiling in the process of brewing tea.

The initial studies were aimed at nutrifying dry tea to a level of 125 IU of vitamin A per gram. The usual adult cup holding 150 ml of tea brewed from 3 g of dry fortified tea would supply 375 IU of vitamin A, however, other vitamin A levels are also possible Tea leaves are sprayed after fermentation stage near the final drying stage. The cost of fortification is negligible and can be absorbed in the overall price of tea without affecting the consumer price.

It has also been demonstrated by small scale manufacture that tea can be fortified successfully with lysine. Five cups and 3 cups a day of this fortified tea will meet the lysine requirement of an adult male and female, respectively.

Fortification of Sago

Tapioca is a tuber grown and consumed in some parts of southern India. This tuber is used as a staple food in various forms one of which is sago. Chemically the tuber and its product contain only starch and lack protein. A project for the fortification of sago had been undertaken by Govt. of India. The objective of the project was to incorporate proteins, vitamins and minerals in sago so that it can be brought nutritionally at par with other staple cereals. The methodology involved in the scheme has resulted in the development of a product which is nutritionally better and is readily accepted by consumers. A proposal for setting up a Pilot Plant for commercial production of fortified

sago in collaboration with some Public Sector Undertaking has been under active consideration of the Govt. of India.

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NOTES & NEWS

Fifth National Symposium on Radiation Physics

The Fifth National Symposium on Radiation Physics was held in Calcutta during November 21-24, 1983, sponsored by the Indian Society for Radiation Physics; Variable Energy Cyclotron Centre, BARC; Saha Institute of Nuclear Physics; Indian Association for the Cultivation of Science and the Calcutta University. About one hundred and twenty-five scientists and research scholars working in the field of radiation Physics at various universities and national laboratories from all over India attended the symposium. Twelve experts were invited to deliver talks at the symposium, six of them being from outside India.

The inauguration took place at 10 a.m. on November 21, 1983 at the Indian Association for the Cultivation of Science, Jadavpur, where the proceedings of the first day also took place. Dr. P. K. Iyenger, Director, Physics and Chemical Groups, BARC, inaugurated the symposium. Prof. B. D. Nagchowdhuri gave the keynote address. Prof. Nagchowdhuri traced the history of radiation physics, or in fact, that of nuclear physics and emphasized the need of interdisciplinary research. He indicated new areas where research effort can be directed and mentioned lioluminescence as an example.

Prof. R. H. Pratt, University of Pittsburgh, USA, in his talk on atomic photoelectric effect surveyed the theory and experiment for atomic photoelectric effect in the x-ray and gamma ray regimes. Contributed papers in the first session on basic interactions described the calculation and measurement of cross-sections. Prof. A. M. Ghose, Universiti Sains Malaysia, reviewed the experimental measurement and theoretical calculations on coherent scattering of gamma rays of moderate energies. Contributed papers on this session on radiation sources and machines discussed the production of neutrons, low energy external bremsstrahlung and fluorescence. Dr. C. V. Sundaram, Reactor Research Centre, Kalpakkam, described the experiments carried out on steel in order to find the structure and properties of metals and alloys altered in a radiation environment. Contributed papers in this session on basic interactions described mainly the photoelectric and Compton interactions of gamma rays.

The second day's proceedings were held at the Saha Institute of Nuclear Physics, 92, A. P. C. Road. Prof. S. N. Chatterjee, Saha

Institute of Nuclear Physics, discussed the role of cell membranes as primary targets in causation of cancer due to non-ionising radiations. Contributed papers in this session on radiation biophysics, biology and chemistry described various effects of radiation on living cells and chemical compounds. Prof. V Lakshminarayana, University of Singapore, described the chemical effects produced by the interaction of low energy gamma photons. Contributed papers in this session on radiation effects dealt with CR-39 films, $CaSo._4$ Dy TLD, nuclear grade silicon, radioactive thermal springs and radon dosimeters. Prof. D. B. Isabelle, University of Clermont, France, described the devalopment of computer assisted single photon emission tomography and positron emission tomography and compared the qualities of both the techniques and their potential future. Col. N. Lakshmipathy, Institute of Nuclear Medicine and Allied Sciences, made a critical evaluation of the relevance of radiation protection in hospitals and stressed the need of stricter control. The contributed paper in this session on medical applications of radiation physics described the neutron activation analysis of trace elements in cancerous human breast tissue. Prof. T. Nakamura, University of Tokyo, presented the calculation and measurement of the angular distributions of neutrons and photons from thick targets of iron, copper and lead bombarded by light heavy ions of various energies. This talk was followed by a poster session on basic interactions.

The venue for the third and fourth days' programme was the Variable Energy Cyclotron Centre, Salt Lake. On the third day, Prof. R. Vasudevan, the Institute of Mathematical Sciences, described the radiative transfer of partially polarised light in an anisotropically scattering inhomogeneous atmosphere containing and arbitrary polydispersion of particles. The contributed papers in this session on radiation transport presented various analytical and semianalytical methods for numerically solving the Boltzmann transport equation. Dr. W. B. Gilboy, University of Surrey, U. K., outlined the principles of tomographic imaging describing and assessing various practical systems used for industrial purposes. The potential for industrial tomography with ionising radiations for non-destructive evaluation purposes was illustrated. This session on industrial application of radiation physics had contributed papers on composition study using radiation and radiation damage of materials. Dr. Feroz Ahmed, University of Delhi, presented the steady state and time dependent fast neutron spectra in various multiplying and non-multiplying systems like finite assemblies of natural uranium, enriched uranium, thorium and iron. He had used for his calculations multigroup diffusion equation and the eigen function expansion method. Contributed papers presented in this session on radiation transport described the sophisticated Monte Carlo variance reduction techniques used to solve the transport equation in practical problems. The session on radiation detectors, instruments and methods started with the presentation by Dr. H. Sanjeeviah, University of Mysore, an invited talk: "Energy Transfer in Organic Scintillators" scheduled to be delivered by Prof. N. Umakantha, Karnataka University. The contributed papers were on the development of instruments, techniques and algorithms pertaining to the measurement and detection of radiation.

The fourth day had one session of contributed papers on radiation transport describing mainly the use and generation of cross-section data and new shielding compositions. This was followed by a panel discussions on teaching of radiation physics in the universities. Following the discussion an working group was set up to investigate and report: a survey of the job potential of radiation physicists, a model syllabus for radiation physics at the post graduate level and examination of other alternatives like one year diploma after graduation, etc.

The venue for the sixth national symposium on Radiation Physics in 1985 was decided to be the Reactor Research Centre, Kalpakkam.

P. K. Sarkar

Laser for field and farm

Scientists of the Alma-Ata University, Kazakh SSR, proposed the use of laser biostimulation in poultry breeding.

A brief exposure of eggs to heliumneon rays reduces the incubation period, increases the birth rate of ducklings by 4% and makes it possible to obtain a more viable chicks. Also, the grain seeds treated by laser beams before they are put into the soil yield better sprouts, developed their root systems more rapidly and ears become heavier. The harvest increases by 15-20%. ▭

APN

Ship-loading computer

The first phase of an automatic ship-handling system has started operating at a major transfer complex of Odessa commercial port.

Travelling-cranes, equipped with sensors, with each new turn of the jib transmit to the computing centre of the port information about the weight the cargo and wind velocity. At the same time, the computer storage gets from the display information about type of cargo, its packing and quantity.

Every hour, the computer prepares a complete chart of filling the ship holds. This enables an operator to choose the most economical version of freight arrangement, the use of machines and mechanisms.

The computer also collects, registers and translates into two languages—Russian and English—information about bills of lading. By 1985, computers will assume control of all the basic technological operations in the harbour. ▭

APN

Anti-dust Magnet

Thanks to the Zhdanov Metallurgical Institute, a magnetic device developed by it now makes possible to retain the tiniest particles of industrial dust penetrating through the filters of air cleaners.

The invisible metal dust, getting into the zone of the magnetic field, is polarised and sticks together forming nodular deposits in filters. In so doing, it carries along nonmagnetic particles.

Preventing atmospheric pollution with magnetic traps will, at the same time, benefit an enterprise by enabling it to use the metal waste. ▭

APN

Adaptive digital moisture meter for oil

A new moisture meter has been designed at the Instiute of Automatics, Kirghiz Academy of Sciences, Soviet Union. The operation of the device is based on the dielectric method.

Due to the capacity of the instrument to take into account the properties of the controlled medium, a high accuracy of analysis is ensured. Practically, its results do not depend on temperature fluctuations and changes in the chemical composition of oil. If moisture increases above the permissible limit, light and sonic signals are switched on, they testify to the issue of substandard oil.

The new device has proved to be efficient at oilfields of the Volga area, Siberia, Ukraine, Byelorussia, Turkmenia and Uzbekistan. ▭

APN

Magnetic catcher for well drilling

Hard-alloy and diamond tools are used in drilling prospecting wells. If the cutters of their drill bits are destroyed, the efficiency of operation sharply decreases. If metal slurry is accumulated in the well, emergency situations develop. The existing tools for extracting metal slurry and fragments are inefficient due to the small diameter of wells.

The tool, suggested by the Azerbaijan specialists, operates according to the principle of attracting ferromagnetic elements by powerful magnets. A changeable drill bit is put on the working and face of the catcher's body. This drill bit makes it possible to destroy the rock outcropping in the stope.

The use of the catcher considerably raises the efficiency of the operation of drill bits in small-diameter wells and reduces expenditure on mineral prospecting. ▭

APN

Photosynthesis in deep space

Soviet scientists have advanced hypothesis that the amount of internal thermal energy of the Europe, a satellite covered by a 5 km deep ice, of the Jupiter is sufficient for melting ice in the lower stratum of the ice envelope. On the other hand, the solar radiation reaching the surface of satellite through 1,500 km long and 1-70 km wide crack in its ice-cover can trigger off photosynthesis leading to the birth of unicellular algae and bacteria in the water.

These cracks occasionally open the vast areas of ice-ocean depth of the satellite and emits energy which is sufficient for maintaining life for a number of years. The strength of the ice-cover is very high due to great pressure and low temperature, which, in turn, enables the satellite of the Jupiter to retain his internal thermal energy. □

APN

Use of solar energy to dry farm products

Soviet scientists are designing and testing various types of solar plants for drying farm produce. It will result in saving a lot of fuel consumed for drying raw cotton and silk, melons, grape varieties for raisins and medicinal herbs. The method will also help to preserve 20-30% more nutritive substances in the products than the conventional ones.

The scientists direct the sun rays on the simplest air heaters, having an inclined nielloed surface covered with ordinary glass. The heated air is veneered into the drying chamber where it absorbs moisture from the products being dried. The device has also lessened the time of drying from 8-10 to 2-5 days. What is more important that the air can be reused in a closed circle. The solar power plant can work even at night with the help of storage battery, which is charged at day time during the sunshine.

The specialists are constructing a commercial solar drier at the Turkmenian experimental melon-growing station. They are also planning to build in the near future such a drying installation at the Soyuzlakritsa agroindustrial association for processing licorice. □

APN

Automatic soil analyser

Soviet scientists, in collaboration with their French counterparts, have developed an automatic analyser which can analyse 250-500 samples of soil or plants per shift. Under the prevalent method, such analyses are very time-consuming and a laboratory assistant can carry out not more than 10-15 of them per day. The new analyser can determine content of up to seven elements simultaneously.

In the new equipment, samples of soil or plants are exposed to radiation at a neutron generator which, in turn, leads to the formation of short-lived isotopes of mineral substances, variants of one and the same chemical element differing from one another by only the mass. A gamma-spectrometre registers the gamma rays of the disintegrating isotopes. It then deciphers the signals and punches out a perforated tape showing the content of chemical elements in the sample.

Such analyses indicating what mineral substances are contained in grain crops and in what proportion, what is the content of the nitrogen in soil and what part of it is consumed by plants are vitally necessary for agronomists, plant breeders and soil scientists. □

APN

Anti-rodent paste

Rodents annually gobble up 20% of the world's grain harvest and 42 million tonnes of foodstuffs. Although a variety of poisonous chemicals is used against them, the rodents adapt and recognise the substances by the smell.

Soviet scientists have developed a new means of protection from rodents which they have dubbed algopaste. It is manufactured from algae which grow in inland bodies of water. The paste contains biologically active substances which cause disgust in the animals and scare them away.

The algopaste is equally effective against house mice, voles, common fieldmice, brown rats and Colorado bettles and their larvae. It poses no hazard to man. □

APN

Articles published in this section are for students and general readers for understanding science in the perspective of its fundamentals. We invite science teachers and scientists for contributing articles to this section. Also we shall appreciate comments from our readers on the articles published in this section.—*Ed.*

AEROBIOLOGY AND ALLERGY

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AEROBIOLOGY, a new branch of science, is the study of airborne bioparticles. It draws information various disciplines like ecology, mycology and plant pathology, palynology, biochemistry, immunology and clinical medicine. According to the IUBS Commission on Aerobiology, it has been defined as "Aerobiology is a scientific discipline focussed on the transport of organisms and biologically significant materials by the atmosphere". The term "aerobiology" was introduced in the 1930s by F. C. Meir of the U. S. Department of Agriculture. W. C. Jacobs (1951) elaborated the term to include dispersion of bacteria, virus, molds, fungal spores, pollen grains and insect populations and their impact on all forms of life both plants and animals which became airborne and transported partly or wholly by the atmosphere. Precisely, the "flora of air" falls under the realm of aerobiology. This branch may just be called a synthesis of subjects dealing with the identity, behaviour, movements and survival of micro-organisms in air.

Interest on the nature and behaviour of organisms present in the air created during the middle of the last century when L. Pasteur (1861) proved in his classical experiments that air is the carrier of many common germs. Since then, several groups of investigators with varied objectives have gathered a large amount of information on the microbial population of the atmosphere. C. H. Blackley (1873) demonstrated by performing experiments on himself and his patients that the pollen grains of grasses were responsible for causing hayfever. M. Wyman (1876) identified the pollen grains of *Ambrosia* (Asteraceae) as the principal causative agent for seasonal hayfever in the United States. W. P. Dunbar (1903) repeated similar experiments and concluded that pollen grains are actually the cause of hayfever. L. Noon (1911) published the first successful results in the treatment of hayfever by the subcutaneous injections of pollen antigenic extracts.

A survey of the available literature would point out that the study of aerobiology has yielded information not only on the airborne bioparticles but also on the allergenic properties of these commonly occurring particles as organic pollutants. Various types of airborne bioparticles have been proved to be potent in terms of causing hayfever and respiratory tract allergy. Pollen and spores are the major organic constituents of the atmosphere. They cause widespread upper res-

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piratory tract and naso-bronchial allergy with manifestations like asthma, seasonal rhinitis, various types of bronchial troubles, etc. The harmful effect caused by their presence in the atmosphere has included Scientists to take up several lines of research programmes : (1) Production and dispersal biology of pollen grains and fungal spores ; (2) Floristic survey and pollination ecology ; (3) Analysis of pollen and fungal spore antigens and the study of their clinical significance ; (4) Biochemical aspect of pollen/spore allergens ; (5) Storage microbiology ; (6) Aerobiology and plant pathology in relation to microbial pollution and their relevance to diseases of crop plants in field and diurnal variations ; (7) Handling of occupational and airborne diseases ; (8) Techniques pertaining to trapping of airborne particles.

The magnitude of the problem related to various types of allergic diseases in India is rather alarming. Morbidity surveys in Delhi and Patna have revealed that more than one percent of the population of this country (about 6 million) suffer from bronchial asthma. According to D. N. Shivpuri (1968) allergic rhinitis affects about 6 to 8 percent, allergic dermatosis 4 to 6 percent, bronchial asthma 1 to 2 percent and other allergic diseases 3 to 5 percent of our population. Thus at least 15 percent of the population of India suffers from major or minor allergic diseases at one time or other.

Respiratory diseases caused by pollen grains are defined as a special case of hypersensitivity by a kind of protein, which under favourable circumstances, gets discharged from pollen grains. It varies in toxicity to sensitize according to the offending nature when it enters the human respiratory system. It has also been found that some distinct allergenic substances exist within the pollen grains. But each allergenic substance may differ in its immunogenicity in the context of its general ability to stimulate IgE antibody response in allergic subjects due to differences in physico-chemical structure, particularly molecular size. Each allergic individual responds in quantitatively (and often qualitatively) in different degrees to the different allergenic substances to which the patient is exposed. It is now known that only a certain number of the general population are allergenically predisposed and that allergy tend to segregate among the members of particular families. Thus, within the human population it seems reasonable to assume that genetic factors are of great importance in determining an individual's general susceptibility towards allergy. Further, important characteristics of allergic sensitization are the route of entry of the allergen, which occurs primarily by inhalation or ingestion and also the allergen dosage which is extremely low, especially for inhaled allergens such as pollen.

Investigations on the role of pollen grains and spores as inhalent allergens was a necessory development and its importance was reflected in Hyde's definition of palynology as "the study of plant spores and their dispersal and applications thereof". Research on the continuous survey in the daily occurrence of pollen grains of various plant species in the atmosphere in relation to respiratory allergy has three major aspects : (a) the botanical aspect—pollen grains are botanical objects ; they are the carriers of the fully developed male nuclei, thus of genes, and consequently of genetic characteristics, (b) the meteorological aspect—the occurrence of pollen grains in the atmosphere and their dispersal through the atmosphere are both influenced by constantly changing meteorological conditions, (c) the medical (allergological) aspect—the disease of the upper respiratory tract caused by pollen is of an allergic nature.

Pollen grains are the male reproductive units of the flowering plants. When the pollen grains get matured i.e. ready for pollination, they get liberated and are dispersed by wind, water or animals including insects to reach its ultimate destination to execute fertilization. The pollen grains produced by anemophilous plants are generally light and occur in large quantities, whereas the pollen produced by entomophilous plants are relatively larger, heavier and occur in lesser quantity. According to the way in which the pollen of a given plant species is dispersed can be classified into three groups : (a) Anemophilous plant species : the pollen is dispersed by wind, (b) Entomophilous plant species—the pollen is dispersed by insects, and (c) Amphiphilous plant species—the pollen is dispersed by wind as well as by insects.

P. H. Gregory (1952) proposed the term "Air-spora" to describe airborne pollen grains and fungal spores the composition of which varies from place to place. A clear understanding of the prevalence of the types in a given area is essential for : (a) deciding what allergens to test for ; (b) identification of the most common offenders ; and (c) diagnosis of the offending agent in a patient so that individual hyposensitization therapy for allergy can be undertaken.

The term "Allergy" was coined by von Pirquet in 1906. It is defined as an altered and accelerated reaction of a person to a second or subsequent exposure to a substance to which his body has already become sensitized by a previous exposure. Hayfever (Seasonal allergic colds) and allergic bronchial asthma are well known examples of allergic disorder, caused by substances termed as allergens, which are otherwise harmless to healthy people. Allergens are generally substances of high molecular weight such as proteins, glycoproteins, or carbohydrates of foreign animal or vegetable origin, although they may also be complexes formed by chemical modification of the host's own proteins by "allergenic haptens". Allergic reactions may occur in many different organs or tissues. If the lower respiratory tract, lungs or bronchi are affected, the clinical reaction will be that of asthma. Other reacting organs may be the skin (urticaria), the gastrointestinal tract, the central or peripheral nervous system, or the cardiovascular system. The organs involved in the allergic reaction is commonly referred to as the "Shock organs".

Allergy to pollen depend on the species, concentration, method of contact and the persons prior history of exposure. Other factors such as abundance of plants, time of the year and weather during anther dehiscence also affect the allergic response of a sensitive person. Five properties of pollen are generally considered essential requirements for a species to cause reaction in man : (a) The pollen must contain a hayfever allergen, (b) the mode of pollination must be by wind; (c) the plant must produce large quantities of pollen, (d) the pollen must be buoyant and transportable, and (e) the plant should be widely distributed. However, all these criteria are not equally valid, e.g. it has been proved that entomophilous pollen would also be responsible to cause respiratory disorders; small quantity of pollen also may cause trouble and it is not always necessary for plants to be widely distributed to cause allergy. It is often seen that locally confined plants also cause large scale allergy.

In India substantial work has been done in different laboratories. The initiative came from D. D. Cunningham (1873) in his pioneering treatise on the aerobiology of the atmosphere of Calcutta with the object of establishing a relationship, if any, between the number and types of airborne particles and the prevalence of the so-called "Zymotic diseases". After a long gap the resurgence of aerobiological activities took place in different places. Chanda and Mandal (1980) have reviewed the work on the ever-changing airspora of India. Aeroallergens in India vary in character from place to place due to differential vegetation and diverse meteorological conditions. In India the clinical investigations of the micropollutants like airborne pollen and spores for the treatment of patients of respiratory allergy are carried out at the four main centres, viz. V. P. Chest Institute, Delhi ; S. M. S. Medical College, Jaipur; K. G. Medical College, Lucknow; and Bose Institute in collaboration with the School of Tropical Medicine and Institute of Child Health, Calcutta.

In India, the relative dominance of various airborne pollen grains were recorded, where grass grains were found to be occurring in highest frequency. The incidence of grass pollen grains in the air is followed by Amaranthaceae, Arecaceae, Chenopodiaceae, Asteraceae, etc. It has been found that a number of entomophilous plants also release fairly good amount of pollen in the air. In India the pollen and pollination calendar for the cities like Delhi, Calcutta, Bombay, Nagpur, etc., have been prepared. The pollen grains of the plants like *Amaranthus*, *Argemone*, *Chenopodium*, *Cynodon*, *Holoptelea*, *Morus*, *Prosopis*, *Xanthium*, *Ricinus*, *Ailanthus*, *Carica*, *Phoenix*, *Cassia*, *Cucurbita*, *Lantana*, *Cocos*, *Calophyllum*, *Eleusine* *Azadirachta*, etc., have been found to be allergenically significant through clinical tests.

In view of the significant contributions made by the Indian aerobiologists, a few workshops on the progress of aerobiology were held in different places in India in 1980. One of these was at the Bose Institute, Calcutta which was held under the joint sponsorship of the Bose Institute and the British Council, where delegates assembled from different Institutions and Universities from all over India to attend the workshop for a better orientation of their future research programmes in various aspects of aerobiology, both theoretical and practical.

Allergic diseases are one of the most important problems of the human pathology all over the world. One of the possible ways to deal with these problems is to establish a monitoring net of the concentration of the airborne allergens of biological origin. Pollen grains are very well-known allergens and in many countries a close collaboration between botanists, palynologists, immunologists and allergologists has been developed or is being developed. Collaboration with meteorologists is necessary in order to understand their liberation, dispersal and deposition. Meteorologists, for instance, can trace back airmasses by using pollen as markers. In this country we have no integrated and coordinated national programme yet. It is now time that we think and plan to pull all the resources for aerobiological monitoring, prediction and warning into a scheme of optimum value to the human and plant population in terms of medicine and plant pathology. The system, when effective, might contribute more directly and more immediately to the benefits of people. ☐

LETTERS TO THE EDITOR

Phase-diagrams and elementary topology

In this communication we draw the reader's attention to some interesting theorems which follow on applying well-known topological theorems[1] to phase-diagrams. Thus the Four-Colour-Theorem (in relation to colouring geographical maps) when applied to phase-diagrams (which are also some kinds of maps) leads to the conclusion that the maximum number of sectors in a diagram, such that each sector has a (non-pointlike) boundary with all the other sectors, is four.* Another theorem results from the application of the rule connecting the number of vertices (V), the number of lines (L) joining them and the number of area-elements (A) in a plane figure of arbitrary complexity. The rule is:

$$V+A=L+1$$

In Delachet's book a proof of this rule

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* By (our) definition a sector corresponds to a phase for a one-component system, but may be a multi-phase region, for a many-component system.

is given. We shall apply this rule to show that in a phase-diagram; the number of sectors (N_S); the number of phase boundaries (N_B); and (N_P), the sum of the numbers (N_n) of n-tuple points[*] ($n \geqslant 3$); i.e.

$$N_P = \sum_{n=3}^{\text{Max. allowed}} N_n; \text{ are related by } N_S + N_P = N_B + 1.$$

To prove this theorem; we introduce the notion of a dual-diagram to a phase-diagram. We first define a dual-point. Any arbitrarily chosen point inside the area belonging to a sector will be called a dual-point to that sector.

A dual-point is chosen for each sector. The boundary between two sectors (a phase-boundary) is replaced by a dual-line which joins the appropriate dual-points. On connecting the various dual-points by the dual-lines we generate a complicated (plane) figure; in general a set of adjoined curvilinear polygons (see Fig. 1 for the 'dual-diagram' to the phase-diagram of water).

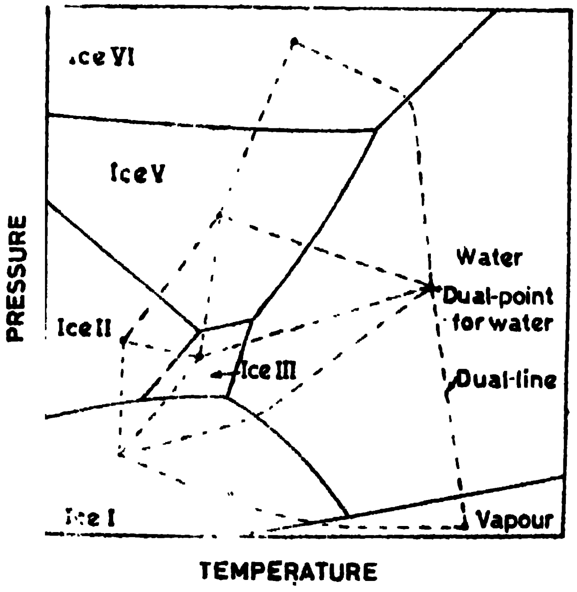

Fig. 1. Phase Diagram of water

We can apply the rule about plane figures to this 'dual-diagram' and conclude that the number of area elements (N) is given by $N = N_B + 1 - N_S$. We next assert that to each area element of the dual-diagram corresponds one and only one n-tuple point of the phase-diagram (the value of n being equal to the number of vertices of the area-element). Thus there are ($N_B + 1 - N_S$) points of confluence; i.e. $N_P = (N_B + 1 - N_S)$ n-tuple points ($n \geqslant 3$). For example; in Fig. 1 there are 6 points of confluence; each of which is a triple point ($n = 3$). In general, n may have different values at different points of confluence.

Now to prove that to each area element of the dual-diagram corresponds a unique point of confluence of the phase-boundaries, we first note that we indeed expect such a result on intuitive grounds: Remembering that each area-element (sector) of the original phase-diagram was replaced by a 'vertex' (dual-point) in the dual-diagram we expect that each area-element of the dual diagram would contain a 'vertex' of the phase-diagram. In the following we give a proof of this theorem:

Consider the polygon ... ABCDEFG ... (Fig.2a)[*].

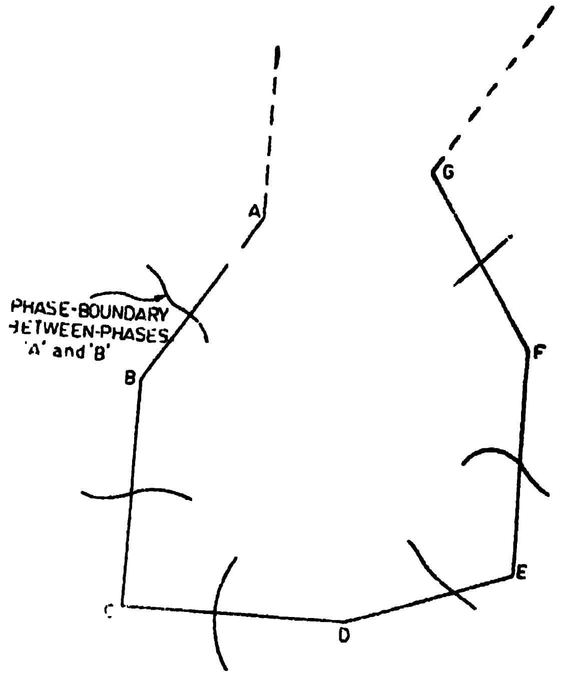

Fig. 2a

According to the rule for constructing a dual-diagram, one phase boundary runs across the side AB of the polygon, another across BC and so on for each side of the polygon. Now to ensure that there does not exist a boundary between sectors ...A, B; F; G; and sector D, *it is* sufficient that the configuration of the phase-boundaries be as shown in Fig. 2b. Unfortunately then sectors C and E become one and the same. To prevent this and also to eliminate the possibility of a phase-boundary between C and E, it is sufficient to introduce an extra sector (the squarish (shaded) area-element in Fig. 2c, bounded by dashed lines on three sides). But this sector does not exist; otherwise we would have a dual-point corresponding to this sector. The only alternative left is to reduce this 'extra' sector to a point, so that the boundaries meet at O. Next to ensure that C does not communicate with ...A, F, G,... and that E does not communicate with ...A, B, G,... it is sufficient to introduce the sector (shaded) lying in the middle of Fig. 2d, bounded by dashed lines on two sides, which does not exist. One (casual) suggestion is to let the boundaries meet at ó. But this leaves open the possibility of a phase-transition (a dual-line) between B and E, which does not exist. Consequently ó must coincide with O. Proceeding in this way, picking up successive pairs of points (like A and G) we can show that the phase-boundaries bounding these sectors (and crossing the sides of the polygon) must meet at O. Finally, it is easy to see that there cannot be a second such point, since the same can be realized only at the cost of introducing non-existent sectors. This proves our assertion that there exists one and only

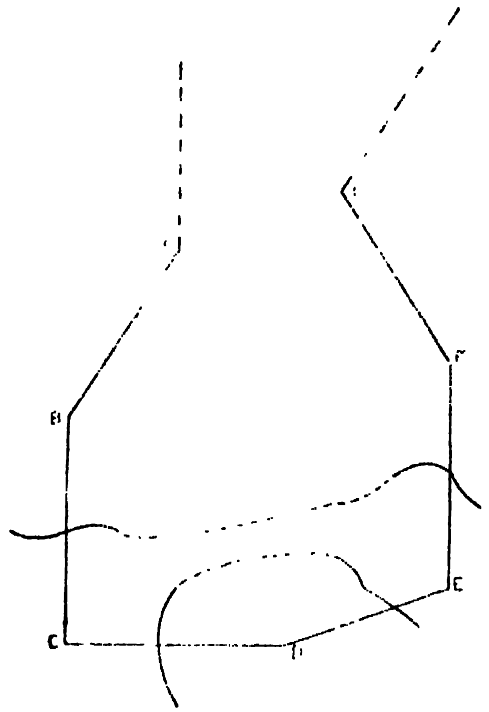

Fig. 2b

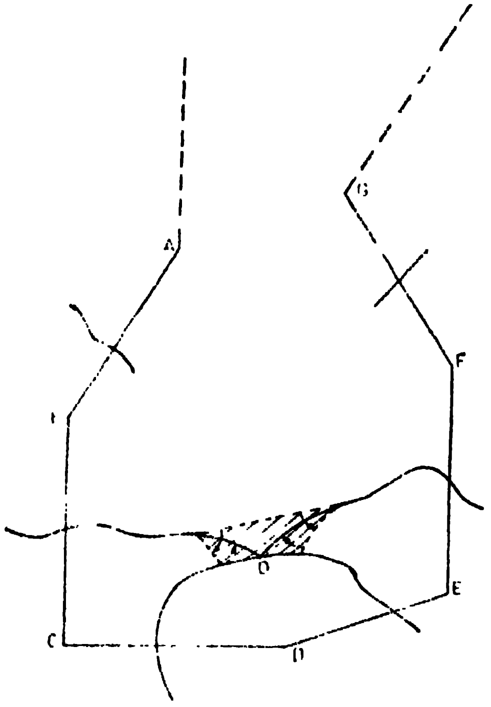

Fig. 2c

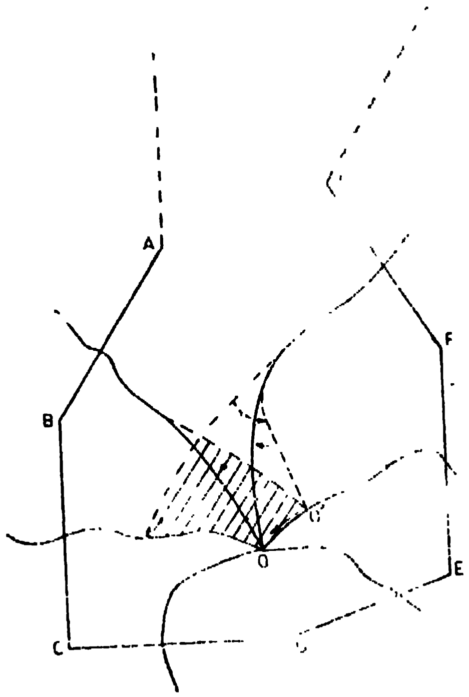

Fig. 2d

one n-tuple point per area element of the dual-diagram.[4]

Lastly, it is amusing to note that Descartes' theorem (given a simple polyhedron having F *f*aces, P vertices (*p*oints) and C edges (*c*onnectors), there exist among these numbers the relation $P-C+F=2$) can profitably be exploited to remember the Phase—Rule[6]. It is easy to recover Descartes' theorem by figuring out the relation between the numbers of vertices, edges and faces of any arbitrary (simple) polyhedron (say, a cube). It is also rather 'natural' to correlate degrees of *f*reedom with *f*aces, both being represented by the symbol (F), implying that vertices (*p*oints) correspond to *p*hases and *c*onstituents to edges (*c*onnectors).

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2 A n-tuple point is a point of Confluence of n-phase boundaries.
3 The proof goes through the same way if the sides of the polygon are curved.
4 We do not claim to be able to locate the n-tuple point in this way, we only show that there exist one somewhere inside.
5 A. Delachet, *loc. Cit.*
6 Mark. W. Zemansky, Heat and Thermodynamics (Fifty Edition), 612, 622, (McGraw—Hill—Kogakusha).

Studies on the non-germination of teliospores of *Ustilago scitaminea* Syd. on the stigma of sugarcane flowers

Several smuts of graminaceous plants are known to infect their hosts through the stigma and style[1,2]. However, in sugarcane true seed infection by the smut fungus *Ustilago scitaminea* Syd. is rare. The possible cause for this was examined in this study since it could have profound epidemiological implications.

Freshly collected teliospores of *U. scitaminea* from several smut whips were mixed thoroughly. In the early morning between 5 and 6 a. m. the spores were dusted on the spikelets with receptive stigmata of susceptible varieties Co 6304 and Co 975. The inoculated inflorescences were covered with cloth bags supported by bamboo cages. At intervals of 24, 48, and 72 hr., 20 spikelets from each of the dusted inflorescence were dissected, the gynoecium stained with alcoholic lactophenol cotton blue stain, washed in glycerine, mounted in glycerine jelly and microscopically examined.

The total soluble sugar content of the stigmatic exudates of the spikelets was determined colorimetrically by the method described by Hodge and Hofreiter[4]. Small strips of Whatman No. 1, filter paper were weighed. The exposed stigma of about 100 freshly opened spikelets were blotted thoroughly on one weighed filter paper strip for each variety. Spikelets from two inflorescences were collected and treated as two replications. The strips were then immediately weighed without loss of moisture. The weight of the exudate alone was found by difference. The strip was then cut into small bits, extracted with small quantities of 80% ethanol and the final volume made up to 10 ml. Two ml of the extract was mixed with 0.5 ml of 80% phenol in a test tube and to it 5 ml of pre-chilled sulphuric acid (AR) was added rapidly, shaken well and kept in a water both at 25-30°C for 5 min. The yellow colour developed was read at 490 nm in a spectrophotometer. Blanks were prepared by substituting distilled water for the sugar extract. A standard curve was drawn using pure glucose and the quantity of total sugars in the sample was determined as glucose equivalent.

Germination of teliospores of *U. scitaminea* in different sugar concentration was assessed. A spore suspension of 10,000 spores/ml was taken separately in sucrose, fructose and glucose concentrations of 5, 10, 15, 20, 25, 30, 35, 40, 45, 50 and 55% in sterile water. A drop of the suspension was spread on a sterilised slide and after an incubation of 8 hr at 30°C the percent spore germination was determined. Four replicates were examined.

The results showed that germination of spores on the stigmata did not take place even upto 72 hours after dusting. The spores were seen adhering to the stigmatic papillae, while there was no evidence of germ tubes emerging or penetrating down the style. The content of total soluble sugars in the stigmatic exudates was equivalent to 32.27 and 38.64% for Co 6304 and Co 975, respectively. Spore germination was slightly enhanced by a sugar concentration of 0.0-5%. Concentrations upto 25% did not markedly affect germination. Concentrations above 25% distinctly reduced germination and a sugar concentration of 55 per cent almost completely inhibited spore germination (Fig. 1).

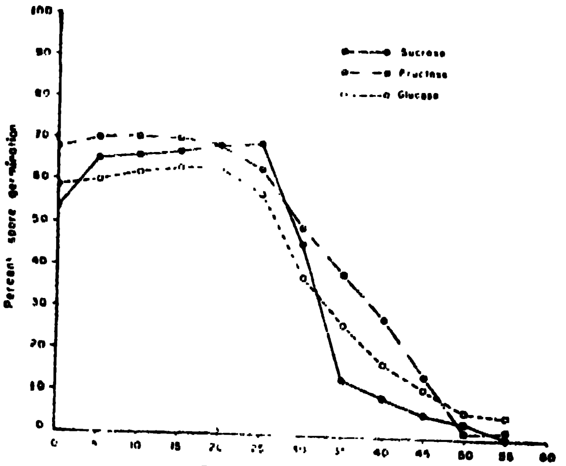

Fig. 1. Germination of teliospores of *U. scitaminea* in different sugar concentrations

It is apparent that the general absence of seed transmission of sugarcane smut is partly due to the non-germination of the teliospores on the stigma. As in case of *in vitro* germination, the high concentrations of soluble sugars in the stigmatic exudates is inhibitory to the spores. On the contrary this high concentration seems to stimulate germination of sugarcane pollen, since a sucrose concentration of 26-32% is known to result in very high germination of sugarcane pollen[5]. Thus, it is probable that the non-germination of smut spores on the stigma is attributable to their inhibition by the high concentration of soluble sugars in the stigmatic exudate causing a high osmotic tension or other effects. This has been indirectly supported by low germination of spores in sugar concentrations above 25 per cent.

Rare observations of smut in early stages of seedling growth are due to shoot infection caused by seed borne teliospores or their deposition on germinating seedling as in case of artificial inoculation techniques followed by Duarte and Tokeshi[2] and Bleicher and Tokeshi[1].

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Pollution induced fish kills in Adyar estuary, Madras—a case study

In recent years, pollution problems are encountered in many estuaries since they receive industrial effluents, municipal and domestic sewage wastes mostly in untreated condition. Although municipal and domestic sewage wastes are generally the major sources of pollution, industrial establishments are the principal sources of controllable water borne wastes. Industrial wastes have a direct impact on the aquatic ecosystem, affecting water quality, living organisms and even aesthetic quality[4,9,14,15]. Moreover, in the face of industrialization, discharge of heavy metallic toxicants are of great concern in the management of marine and estuarine ecosystems[8,10,12,13]. Thus, study of physico-chemical characteristics of the water after the discharged wastes is important for understanding the pollution problem and suggesting remedial measures[25].

In tropical waters, fish kills may be due to some natural causes such as temperature, salinity changes, low dissolved oxygen levels, parasites, bacterial and viral epidemic diseases. Pollution caused fish kills may be attributed to industrial, municipal and domestic wastes, agricultural wastes and water control activities. The over enrichment of estuarine waters by sewage discharge wastes can expand and modify the estuarine microbial flora and so diseases and mortality results.

Madras is an industrialized city. Major industries like Hindustan Teleprinters, Indian Drugs and Pharmaceuticals Ltd., Madras Surgical Instruments, Britannia Biscuits, numerous other private industries engaged in electroplating, plastics, battery and electrical goods manufacture, textils, chemical industry, pigment colouring and paint factories, motor spare part manufacturing units, private hospitals and government institutions like Guindy Engineering College and King Institute, Slaughter houses, many Cemetries and Crematoriums are located around the Adyar estuary. Further, it has been estimated that about 7,75,000 litres/day of industrial effluents carrying heavy metallic elements are discharged into this river system[30]. Another source of contamination that poses a danger to the aquatic life in this river is the discharge of untreated domestic sewage which adversely affects the water quality. The quantum of domestic sewage output in Madras Metropolitan area has been estimated to be about 51 million gallons/day and about 1.8 million gallons/day is allowed to flow into the Adyar river system[32].

Adyar estuary (13° 1′ N and 80° 17′E) extends from the Guduvancheri hills in the Kancheepuram taluk of Chinglepet district of Tamil Nadu and runs for about 30 km towards the southern border of Madras coast. The estuarine part of the Adyar river runs perpendicular to the sea coast and mixes with the sea near foreshore estate, Madras. The surplus water of Chembarampakkam irrigation tank and the natural flood drainage water are also allowed to flow into the river system. The present study was undertaken in the estuarine area extending for about 0.8 km from the mouth of the estuary.

Many workers have studied the effects of industrial and sewage waste releases on water quality, fish and other aquatic organisms in the river, estuarine and marine ecosystems[8,11,16,20-22,29,31-34]. Pollution problems in Adyar estuary have been dealt with by some earlier workers[11,26,27]. However, informations regarding the level of industrial and sewage pollution load in the Adyar estuary and their effects on fishes and other aquatic organisms are still lacking. Hence, the present investigation on fish kills may help to evaluate the quality of water in the Adyar estuary for its remedial measures.

The present study deals with an account of the investigations carried out during 1979-80 on the fish kills associated with the discharge of industrial and sewage wastes in the Adyar estuary. Further, hydrological conditions of the water and their consequent impact on the fish kills in the vicinity of industrial and sewage discharge points in the estuary are discussed.

In many estuaries, dissolved oxygen levels are usually the parameter used to evaluate water quality because they can be readily measured and have easily understood effects on aquatic life[21-24]. Hence, dissolved oxygen levels are frequently employed as a primary water quality indicator and are the basis for the present study. Though, Adyar estuary is highly polluted by industrial and sewage waste discharges, the favourable conditions for fish, invertebrates and other aquatic organisms for feeding, attainment of growth and breeding prevails till the closure of the bar mouth of the estuary. As soon as the bar mouth closes around June-July every year, increase of bacterial concentration due to industrial and sewage waste discharges outbreak diseases and decrease of dissolved oxygen levels resulting heavy mortalities.

Mass kills of fishes and other aquatic organisms occurred due to high oxygen depletion during June-July, 1979 and 1980 as soon as the bar mouth of the Adyar estuary was closed. The list of dead fishes is given below (Fig. 1).

Fig. 1. Fish Kills in Adyar estuary, Madras

Mugil cephalus (Linn)* ; *Liza macrolepis* (Smith)** ; *Liza waigiensis* (Quoy and Gaimard)* ; *Liza cunneseus* (Forsk)* ; *Liza parsia* (Forsk)* ; *Therapon jarbua* (Forsk)**; *Therapon puta* (Cuv)** ; *Gerres filamentosus* (Cuv)** ; *Gerres oblongus* (Cuv) ; *Gerres oyenna* (Forsk) ; *Ambasis commersoni* (Cuv)** ; *Tilapia mossambica* (Peters) ; *Epinephelus tauvina* (Forsk) ; *Lutianus johni* (Bl) ; *Sillago sihama* (Forsk) ; *Tachysurus thalassinus* (Rupp) ; *Tachysurus dussumeri* (Cuv & Val) ; *Leiognathus splendens* (Cuv)* ; *Leiognathus bindus* (Val) ; *Siganus oramin* (Bl & Sch) ; *Siganus javus* (Linn) ;

Scylla serrata (Forsk) ; *Penaeus indicus* Milne-Edwards* and *Metapenaeus monoceros* (Fab).

The percentage of mortalities of the various species of fishes and other invertebrates was estimated on the basis of visual observation and only representative samples were collected.

About 50% of the dead fishes were washed ashore near Chettinadu Bangalow situated in the southern side of the Adyar estuary.

Hydrological parameters such as temperature, salinity, dissolved oxygen, pH and transparency of the water before and after the closure of the bar mouth of the Adyar estuary for the period from January 1979-July 1980 are given in Table 1. The bar mouth of the estuary was connected to the sea after the North east monsoon during

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* 25% mortality ; ** 50% mortality

TABLE 1 : Hydrological conditions of the water in Adyar estuary, Madras, for the period from January 1979 to July 1980 (Mean values)

Months	Temperature °C Air	Temperature °C Water	Salinity %	Dissolved oxygen ml/l	pH	Water transparency (cm)	Tide	Nature of bar mouth
January	25.9	27.0	7.14	4.02	6.5	29	Low	Open
February	26.7	27.2	21.03	3.57	7.7	44	High	Open
March	28.3	27.8	26.05	4.30	7.5	57	High	Open
April	30.1	29.1	70.73	3.12	8.0	50	High	Open
May	31.7	30.7	17.41	4.24	7.7	56	High	Open
June	30.7	28.2	16.70	1.42	7.5	41	—	Closed
July	29.7	28.2	14.63	0.62	8.5	48	—	Closed
August	29.2	28.0	17.08	0.04	7.6	45	—	Closed
September	28.6	28.2	7.88	0.52	7.2	46	—	Closed
October	29.7	29.9	7.34	3.69	8.6	49	Low	Open
November	28.0	27.1	15.07	3.40	8.1	38	High	Open
December	27.4	26.0	5.01	3.14	7.7	40	High	Open
January	28.0	27.1	13.72	3.80	7.6	42	Low	Open
February	28.0	27.2	24.65	4.45	8.0	60	High	Open
March	30.6	30.0	25.37	4.29	8.0	58	High	Open
April	32.0	32.9	20.93	4.15	7.8	41	Low	Open
May	30.0	30.8	23.26	4.07	7.5	46	High	Open
June	31.0	32.0	10.3	0.62	7.1	42	—	Closed
July	29.8	28.1	11.62	0.89	7.0	40	—	Closed

October-December and again closed during June-July.

Further, the concentration of some of the heavy metals in the gill, liver and muscle tissues of natural populations of mullet *Liza macrolepis* (Smith) inhabiting Adyar estuary which represented 50% mortality in the present observation were studied. Such a study indicated relatively high bioaccumulation of heavy metals. For instance, the bioaccumulation of heavy metal such as mercury in fishes of Indian Ocean is known to be in the range of 0.06 ppm (gills), 0.04 ppm (liver) and 0.10 ppm (muscle). But mullets, *Liza macrolepis* (Smith) in Adyar estuary were found to have a concentration of 0.10, 0.09 and 0.12 ppm in gills, liver and muscle tissues respectively which is about 40%, 50% and 20% higher than the reported concentration. Similarly, the bioaccumulation of cadmium in various tissues of fishes from clean marine environments was in the range of 0.31 ppm (gills), 0.34 ppm (liver) and 0.70 ppm (muscle). On the contrary, mullets *Liza macrolepis* (Smith) from Adyar estuary were found to have a concentration level of 0.74 ppm, 0.78 ppm and 1.55 ppm in gills, liver and muscle tissues respectively which is about 41%; 44% and 45% higher than the reported levels. It stands to reason that mullets have accumulated the said heavy metals from the ambient environment. Consequently, it is inferred that high levels of mercury and cadmium in the ambient water may be due to the discharge of industrial and domestic sewage wastes into the Adyar estuary. Further, it may be seen from Table 1 that dissolved oxygen levels of the water ranged from 0.04 to 0.89 ml/l during the months June-July; 1979 and 1980. Salinity of the water also decreased due to the release of fresh water laiden with industrial and domestic sewage wastes and it ranged from 7.8 to 17.0%, while the bar mouth was closed. Therefore, it stands to reason that mortality of fishes and other aquatic organisms occurred due to depletion of dissolved oxygen levels in the water and this could be due to the combined effect of industrial wastes carrying heavy metals and domestic sewage wastes into this estuary.

The effect of low oxygen on the survival and the distribution of fishes has been extensively studied both under natural and laboratory conditions[19,28]. The oxygen requirements for fishes and other aquatic organisms in estuaries was reviewed by many workers[1,5-7]. They have reported that the lethal levels may probably be avoided by maintaining dissolved oxygen levels above 2 ml/l mark. This level may be much lower for some species, while other species may tolerate much lower concentrations[17,18].

Hence, as a remedial solution, it may be suggested that industrial and sewage waste contaminants and their offensive nature of the putricible organic matter brought along with the sewage may be diminished by dispersion due to sufficient dilution enabling the river system to accomplish self purification[3,15,16]. In this process, it is imperative that the river mouth must be kept open if the above purpose is to be achieved. The other processes involved in self purification are reduction, oxidation and sunlight[13,14,22]. Among the biological processes that favour self purification processes such as the devouring action of bacteria on organic matter, algae giving oxygen during photosynthesis and protozoans feeding on bacteria are the sub systems that has to be developed in the estuarine and coastal embayments from the stand point of sanitary engineering.

By way of recommendation, it is suggested that efforts must be made to maintain a constant level of dissolved oxygen in the water by making an year round continuity of the estuary with the sea for protection of fishes and other aquatic organisms in the Adyar estuary. Further, continuous and periodical monitoring may provide us with information as to when exactly the system is brought under stress and when preventive measures are to be undertaken.

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Bi-carpellary pistil in sunnhemp

Flowers of sunnhemp (*Crotalaria juncea* L.) are zygomorphic and monocarpellary like other members of Papilionaceae. In a designed experiment for assessing the quantum of spontaneously evolved male sterility amongst different strains e.g., K-12, ST-55 and ST-42 of sunnhemp, reported elsewhere[1], it was observed that three plants, two of K-12 and one of ST-42 produced flowers (Fig. 1) which were bi-carpellary, unlike other flowers of the same inflorescence. The bi-carpellate flowers appeared single at the top of each first-formed reproduced axis; i.e., infloresence which bore 12-17 flowers arranged in raceme like other inflorescences of the population. In each flower (Fig. 2) two carpels developed normally unlike that formed in other species, viz., *C. spectabilis* Roth, as reported by Biswas[2]. Sizes of petals and carpels were not different in the above bi-carpellary flowers, and stamens, 10, (5+5) were fertile and characteristic of the tribe Genisteae to which the genus *Crotalaria* belongs. Since the species *C. juncea* is self-incompatible[3,4] artificial cross pollination was attempted in bi-carpellate flowers but no seed setting was observed. The number of unfertilized ovules

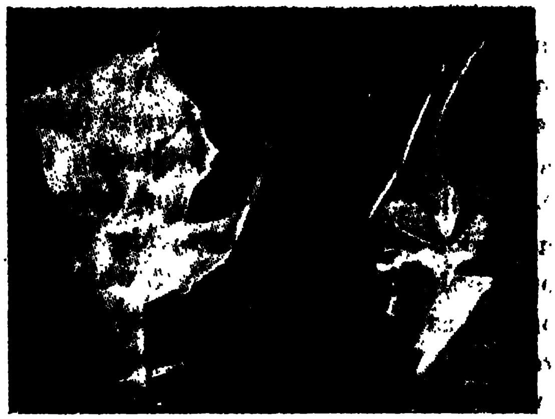

Fig. 1. Bi-carpellary apocarpous pistil in sunnhemp

Fig. 2. Bi-carpellate flowers (4 nos.) each from a single plant

In each of the two carpels of a flower was found same. By artificial close sibmating amongst K-12 flowers one of the progeny was found to bear a first-formed inflorescence (i.e., primary rachis) producing three bi-carpellate and apocarpous flowers in succession at the top of the rachis. It developed only eight flowers, out of which five formed earlier are monocarpellary. Occurrence of both mono- and bi-carpellary flowers in the same rachis indicates the play of dominant and recessive genes for number of carpels which might be a case of reversion or mutation and subsequent somatic segregation. The plant being of a very short stature (32 cm in height) was not found to develop other secondary or tertiary inflorescence fully. However, the irregularity in the formation of bi-carpellary flowers may be due to developmental error subjected to further study.

Occurrence of bi-carpellary and apocarpous flowers was also reported in some other species, e.g., *Inga dulce* Benth and *Poinciana pulcherrima* L. by Khan[5] and Farooq[6] respectively. The appearance of more than one free carpel in this species indicates phylogenetic significance.

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Interfertility and oxidase tests of *Daedalea microzona* Lév.

The species with tetrapolar sexuality are more advanced than the bipolar species according to Nobles[1] who[2] also advanced a hypothesis that species of the Polyporaceae with bipolar sexuality are associated with brown rot of wood and exhibit negative oxidase reaction, while species with tetrapolar sexuality cause white rot and show positive oxidase reaction.

To support the validity of this hypothesis, more citations particularly from Hymenomycetes are needed. The present communication deals with interfertility and oxidase of *Daedalea microzona* Lév., a common species of Indian Polyporaceae.

Fresh sporophores of *Daedalea microzona* were collected from Similipal National Park, Orissa. This fungus caused white rots on dead stumps of *Shorea robusta* Gaertn. f. Identification of the fungus was confirmed by comparing with the material preserved in the Herbarium of Prof. S. R. Bose at Presidency College, Calcutta. Basidiospores were collected from a sporophore in a sterilized Petridish. Twenty monosporous cultures were isolated, following the usual dilution method[3]. Polysporous culture was also established from spore deposits.

The monosporous cultures were paired among themselves in all possible combinations on 2.5% malt agar slants and incubated at 28±2°C. The hyphae from the line of contact between the paired mycelia in each tube were examined microscopically for the presence of clamp connections. In compatible crosses, mycelia showed clamp connections indicating their dikaryotic nature while in incompatible crosses, no clamp connection was observed.

An analysis of the results of interfertility tests shows that the basidiospores of *D. microzona* fall into four groups on the basis of their compatibility to form dikaryons. This indicates that the species is tetrapolar with allelomorphs for heterothallism at two loci. The distribution of mating types among the basidiospores studied is given below following the methods of Nobles *et al*[4]. where the conventional symbols A_1 A_2 B_1 B_2 have been used to designate the alleles governing the interfertility :

A_1 B_1 : 1, 5, 10, 11, 12, 14, 19, 20
A_1 B_2 : 7, 8, 9, 23
A_2 B_2 : 13, 16, 18, 21, A_2 B_1 : 3, 4, 15, 22

Illegitimate pairing—

A_1 B_2 × A_2 B_2 : 9 × 18

The sporophores and cultures were deposited in the Mycological Herbarium of Visva-Bharati University (VBMH).

Oxidase test was carried out by growing the polysporous mycelia for 7 days at 28± 2°C on 2.5% malt-agar medium containing either 0.5% gallic acid or 0.5% tannic acid in separate Petri-dishes following the method of Davidson *et al*[5]. The presence of dark colored diffusion zone which is very strong (++++) in both the media with the diameter of reacting zone 5-6 cm in gallic acid-agar and 7.5-8.5 cm in tannic acid-agar medium presented positive proof of the production of extracellular oxidase enzymes by the test fungus.

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Natural enemies of white grubs

During recent years white grub has been identified as one of the alarming pest from different states of the country. There are many reasons for the outbreak of this pest but it seems that outbreak of this pest is mainly due to large scale depletion of the natural enemies of white grub. Pesticides are in common use for the control of many agricultural crop pest as well as white grubs. These insecticides not only kill the target animals but also kill several beneficial species, which help in suppressing the balance of natural population. Many parasites, predators and pathogens of white grubs have been recorded from all over the world. The existing literatures on natural enemies of white grubs have been reviewed by Veeresh[1]. Recently, Nath and Singh[2] have identified many white grubs endemic pockets in Varanasi and Mirzapur districts of eastern Uttar Pradesh. During investigation 18 species of white grubs belonging to lamellicorn leaf chafer group were recorded. These scarabaeid beetles were of the 3 subfamilies, i.e., Melolonthinae, Rutelinae and Dynastinae which were having 8, 8 and 2 species respectively. Following species were parasitised and predated by different animals (Table 1).

Melolonthinae : *Autoserica nathani*, *A. atratula*, *A. insanabilis*, *Apogonia ferruginea*, *A. unifermis*, *A. roucca*, *A. cribricollis*, *Schizonycha ruficollis*.

Rutelinae : *Anomala bengalensis*, *A. dorsalis*, *A. dorsalis var. fraterna*, *A. ruficapilla*, *Adoretus versutus*, *A. decanus*, *A. limbatus*, *A. lasiopygus*.

Dynastinae : *Clyster trachipygus*, *Eophileurus platypterous*.

A survey of natural enemies was conducted during 1977 to 1982 in Varanasi and Mirzapur districts of eastern Uttar Pradesh

†TABLE 1 : Record of parasites and predators of white grub in Varanasi and Mirzapur districts of Eastern Uttar Pradesh

Sl. No.	Name of organism	Stage	Remarks
A.	Parasite		
1.	Insect		
	i. *Scolia* sp.	Grub	This parasite was collected from sugarcane and groundnut fields at all the sampling sites.
2.	Acarina (Mite)		
	i. Mesostigmatid mite*	Adult	The adult beetle and pupa were found parasitised by mesostigmatid mites. The concentration of mites were mainly on the ventral side of thorasic and abdominal portion of adult beetle. Whereas in case of pupa, mites were attached throughout the pupal body.
B.	Predator		
1.	Insect		
	i. Ant*	Grub	The small tiny ants were found feeding on the grubs and adults in the sugarcane and groundnut fields.
2.	Araneida (Spider)		
	i. *Oxyopes pandae*	Adult	These two spiders were active during the night time on *Acacia arabica* and *Rosa* sp. where the adult beetles of white grubs settle down for feeding. The spiders were seen feeding on beetles.
	ii. *Thomisus* sp.	Adult	
3.	Non-arthropod predator		
	i. Indian toad (*Bufo melanosticus*)	Adult	*Bufo melanosticus* was found feeding on the adult beetles of white grubs near the source of light and under the cover of *Acacia arabica* tree in sugarcane and groundnut fields.
	ii. Lizard		
	a. *Calotes versicolor* Daudin	Adult	These were found feeding on the adult beetles on *Acacia arabica*, *Azadirachta indica* and *Rosa* sp. plants.
	b. *Hemidactylus flaviviridis*	Adult	This species was seen feeding on beetles attracted to light.
	iii. Birds		
	a. Indian crow (*Corvus splendens*)	Grub and adult	All the three birds were found feeding on the adults, grubs and pupae which were exposed after tillage operations.
	b. Indian Mynah (*Acridotheres tristis*)	Grub and adult	
	c. Pigeon (*Columba livia*)	Grub and adult	
	iv. Mammal		
	a. Stray dog (*Cuon alpinus* Pallas)	Adult	These two mammals were found feeding on those beetles which were attracted to the source of light and settle down on the ground.
	b. Stray cat (*Felis constantina* Forster).	Adult	

* Species not identified.

to record the parasites and predators of white grubs in this area.

In the present investigation, the insect parasite *Scolia* sp. and the mesostigmatid mite were recorded and the predators like ants, spiders, lizards, toad, birds, stray dog and cat were seen feeding either at grub stage or adult stage or both stages of white grubs (Table 1). The mesostigmatid mites attacking pupal stage of white grub seem to be a potential group of parasite. The mesostigmatid mites were collected from different sites. There is no information available on this group of mite parasitising pupal stage of white grubs. Therefore, any study on this group of mite parasitising white grubs will be very helpful in establishing this parasite in our country.

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Pollen production in common allergenic plants of Delhi and their atmospheric prevalence

The frequency of pollen present in the air in a given geographical area is conditioned by several factors such as habitat, distribution and floral character in terms of pollen production of various plant species. In order to cause allergic disorders pollen must have certain characteristics such as buoyancy, and allergenic determinant. Although atmospheric surveys for airborne pollen have been conducted at several places in India[1,5], yet they have not been supported in all cases by pollen production studies in these plants. In the present study the pollen production per flower of common allergenic grasses, weeds and trees of Delhi along with their annual contribution to the pollen air spora have been recorded.

Unopen matured flowers from already established allergenic taxa[6,7] were collected from the field. The number of anthers from the flowers of each species were counted. A single anther from the flowers of each species was transferred to glass centrifuge tubes containing 0.5-1.0 ml of 50% glycerine solution. The anther was then gently crushed to make pollen suspension.

A drop of pollen suspension was placed on the microscope slide and its number was counted. Necessary precautions were taken to avoid overflow of the pollen suspension. The whole suspension of each pollen type was counted. From the counts obtained for an anther, the number of pollen grains per flower was determined for each taxa, based on the total number of anthers present in a flower.

The percentage pollen contribution, by each taxa, to the total annual pollen catch was based on average pollen counts for four annual surveys conducted at two different places of Delhi for two consecutive years, i.e. January 1973 to December, 1974[5].

The palynological data for allergenically important grasses, weeds and trees along with their modes of pollination and annual percentage contribution to the total pollen air spora of Delhi are given in Tables 1, 2 and 3.

It transpires from Table 1 that the largest pollen producer, amongst the grasses studied, was *Pennisetum typhoides* (8118) per flower. The lowest counts were obtained for *Bothriochloa pertusa* (198). The airborne pollen grains of grasses could not be characterized upto generic level and hence they were grouped together as Poaceae. The annual percentage contribution by grasses to the total pollen air spora is relatively high, i.e. 26.5%.

The highest pollen production per flower amongst weeds was *Cannabis sativa* (3,86,300) whereas the lowest was *Chenopodium album* (3,360). The pollen of Cheno-

TABLE 1 : Pollen production in common allergenic grasses

Name of Plants	Mode of Pollination	No. of Anthers/ Flower	No. of Pollen/ Anther	No. of Pollen/ Flower	% Annual Pollen Catch
Bothriochloa pertusa	AN*	3	66	198	
Cenchrus ciliaris	AN	3	620	1860	
Cynodon dactylon	AN	3	541	1623	26.5
Imperata cylindrica	AN	3	1447	4341	Poaceae
Pennisetum typhoides	AN	3	2706	8118	*
Sorghum vulgare	AN	3	2566	7698	

*AN = Anemophilous

TABLE 2 : Pollen production in common allergenic weeds

Name of Plants	Family	Mode of Pollination	No. of Anthers/ Flower	No. of Pollen/ Anther	No. of Pollen/ Flower	% Annual Pollen Catch
Amaranthus spinosus	Amaranthaceae	AN*	5	4,380	21,900	12.5 (Cheno-Amaranth)
Artemisia scoparia	Compositae	AN	5	1,930	9,650	2.8
Brassica campestris	Cruciferae	AM**	6	3,071	18,426	1.7
Cannabis sativa	Cannabinacae	AN	5	77,260	3,86,300	2.3
Chenopodium album	Chenopodiaceae	AN	5	672	3 360	12.5 (Cheno-Amaranth)
Cleome gynandra	Cleomaceae	AM	12	3,362	40,344	0.2
Xanthium strumarium	Compositae	AM	5	—	6,278	1.7

*AN = Anemophilous **AM = Amphiphilous

TABLE : 3 Pollen production in common allergenic trees

Name of Plants	Family	Mode of Pollination	No. of Anthers/ Flower	No. of Pollen/ Anther	No. of Pollen/ Flower	% Annual Pollen Catch
Ailanthus excelsa	Simarubaceae	AN*	10	27,620	27,620	1.1
Azadirachta indica	Meliaceae	EN**	9	332	2,988	1.1
Dodonaea viscosa		AN	8	35,870	2,86,960	2.3
Holoptela integrifolia	Urticaceae	AN	7	43,955	3,07,685	1.7
Morus alba	Moraceae	AN	4	41,158	1,64,632	13.0
Prosopis juliflora	Mimosoideae	AM***	10	494	4,940	8.2
Ricinus cummunis	Euphorbiaceae	AN	—	396	—	0.5
Salvadora persica	Salvadoraceae	AM	4	263	1,052	3.1

*AN = Anemophilous **EN = Entomophilous ***AM = Amphiphilous

podiaceae and Amaranthaceae were indentified as Cheno-Amaranth, as both the families possess morphologically more or less similar pollen grains, i.e. multiporate. The pollen contribution to the annual pollen air spora by Cheno-Amaranth was 12.5%. Pollen per flower in *Xanthium strumarium* was directly determined.

Holoptelea integrifolia, a good pollen producer (3,07,685), contributed only 1.7% to the air spora of Delhi (Table 3). Since the number of anthers per flower in *Ricinus communis* are numerous, pollen production per anther (396) only was determined.

Although, grasses are low pollen producers but their cumulative contribution is significant (26.5%) to the atmospheric pollen flora. This is probably due to abundance of herbaceous grasses during the monsoon season. Cereals are probably better pollen producers than the wild grasses, to ensure the fertilization process. Although pollen production per flower is very high in *Holoptelea integrifolia*, it contributed only 1.7% to the annual pollen catch as compared to the higher catches from *Prosopis* and *Morus*. The low pollen contribution by *Holoptelea* is probably because this tree is sparse in Delhi area, whereas *Prospis, Morus* and some other trees grow abundantly. *Dodonaea viscosa* is a poor contributor to the atmosphere, although high pollen producer, as it is subjected to regular prunning in gardens and lawns and thus prohibited from blooming. The pollen of *Morus* are small in size and buoyant, and are therefore significantly high in Delhi atmosphere during its flowering period.

The wind pollinated plants are generally characterized by large production of pollen which in many cases are allergenic. However, it was observed by Pohl[8] that there is no strict relationship between mode of pollination and amount of pollen produced by plants. Pollen production studies in some plants such as *Amaranthus spinosus, Bothroiochloa pertusa* and *Holoptelea integrifolia* are not strictly in agreement with the reports of Nair & Rastogi[9], who adopted slightly different method for determining pollen production.

The pollen production data are not only helpful in the quantitative interpretation of airborne pollen types but are also helpful in the interpretation of the analysis of the deposition of pollen in the soil and vegetational history of the past.

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Rhizogenesis in peach × almond hybrid as influenced by concentrated growth regulators

Cuttings of certain difficult-to-root plant species like peach, almond and peach × almond hybrid fail to root profusely even with the application of soaking treatments of low concentration of growth regulators[1]. In trials of several peach and peach × almond hybrid hardwood cuttings treated with IBA and NAA at rates upto 1000 ppm the results were variable[2,3]. Such information on locally available subtropical peach × almond hybrid cv 'Sloh' was lacking. Therefore, studies were undertaken to ascertain the effects of high concentration quick dip treatments of IBA, NAA and Seradix B_3 (dust application) on the rooting and survival of hardwood cuttings of peach × almond hybrid.

Hardwood cuttings of peach × almond hybrid cv 'Sloh', 18-20 cm long and 0.6-0.8 cm diameter were prepared. The basal 4-5 cm portion of the cuttings were given 30 sec quick dip treatment in IBA and NAA, 500 and 1000 ppm each in 50% ethanol. There were 75 cuttings in each treatment.

In addition peach × almond hybrid cuttings were also treated with concentrated IBA preparation Seradix B_3 (May & Baker LTD., Bombay) in powder form. Fresh cuts were made at the base of the cuttings shortly before they were dipped into the powder.

The control cuttings were dipped in distilled water. Captan was dusted on the cuttings to prevent fungal infection. Later the cuttings were callused in moist sand for 30 days under natural conditions where the temperature varied between 6-12C. After callusing the cuttings were planted in sand beds. The extent of rooting and the subsequent survival of the cuttings were recorded after about 8 months.

The results obtained from the present study revealed that the application of Seradix B_3 was the most effective growth regulator in causing rooting (Table 1). It resulted in 52% rooting success as compared to only 14% in control treatment. It exhibited 256% increase in rooting over control.

TABLE 1 : Effect of growth regulators on the rooting of peach x almond hybrid cuttings

Growth regulator	Concentration (ppm)	Rooting success (%)	Roots/ cutting	Root length (cm)
Control	—	14 —	6	5.8
IBA	500	12 (—13)	10	8.4
	1000	39 (+169)	18	11.4
NAA	500	13 (—4)	9	5.3
	1000	0.0 —	—	—
Seradix B_3	(Dust application)	52.0 (+256)	22	14.4

The values within parenthesis represent per cent increase or decrease over control

IBA 1000 ppm was also effective and it caused 39% rooting. NAA was a little more effective in inducing roots as compared to control cuttings. The low level of rooting success with NAA treatments may possibly be associated with its molecular streochemistry[4]. The inhibitory action of NAA may be due to the fact that during its action, naphthalene, a stable residue of NAA is produced which is known for its phytotoxicity, since the enzyme system causing its oxidation is lacking in plant system.

The higher efficacy of dust application of Seradix B_3 in rhizogenesis has also been reported by Bandopadhyay *et al*[5]. in *Carissa* sps. They reported that Seradix B_3, was most efficient in inducing roots *Carissa carandas* as compared with the other species studied.

Seradix B_3 produced more number of roots (22) as compared to the roots (18) produced by IBA 1000 ppm treatment. The untreated control cuttings produced lowest (6) number of roots (Table 1). Higher root length of 14.4 cm was noted in the cuttings treated with Seradix B_3 which was followed by 11.4 cm root length produced under IBA 1000 ppm treatment. The lowest root length was obtained in the cuttings given NAA treatments.

Thus Seradix B^3 was observed to be the best agent in increasing rooting, number and length of roots in hardwood cuttings.

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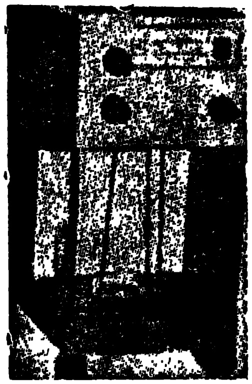

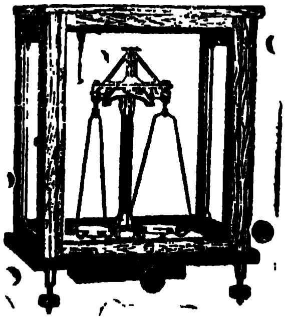

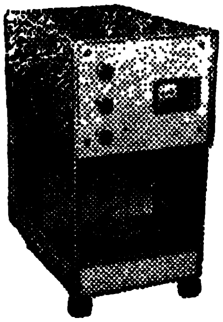

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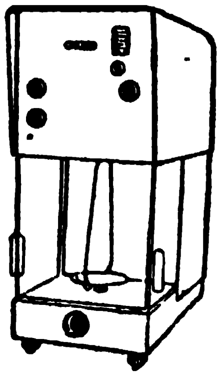

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The Indian Council of Agricultural Research invites applications from post-graduate students who have obtained their Ph. D. degree during the year 1983 in the fields of agriculture/animal sciences (including fisheries) and home science for "Jawaharlal Nehru award for Outstanding Post-graduate Research in Agriculture—1984". There will be ten prizes of Rs. 5,000/- each for outstanding research work of the following nature :—

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Candidates shall be required to submit the following documents through the Head of the Institute from where the thesis has been obtained :—

(1) A copy of the thesis submitted by them for the award of the doctoral degree.

(2) A certificate from the guide of the candidate for Ph. D. degree stating the extent to which the work is the candidate's own contribution.

(3) 6 copies of the synopsis indicating precisely and in concise terms the work done by the candidate.

(4) 6 copies of the bio-data with complete address for correspondence with telegraphic address, if possible.

The certificate awarded to the candidate for Ph. D. degree may also be sent. There is no prescribed proforma for applying for this award. Each candidate will be judged on the basis of the originality and the applied value of the investigations as revealed in the thesis submitted by him. In all matters relating to the award the decision of the Council shall be final and no correspondence on this account will be entertained.

Application with complete documents as mentioned above addressed to Shri K. S. Krishnaswami, Additional Secretary(A), Indian Council of Agricultural Research, Krishi Bhawan, New Delhi-110001 should be sent so as to reach on or before *30th April, 1984.* The last date for candidates in the Andaman and Nicobar Islands, Lakshadweep States/Union Territory in the North Eastern Region, Ladakh Division of J&K State & Sikkim is *16th May, 1984.* The award winning thesis will be retained by the Council for record. In case the application is not accompanied by a copy of thesis and the required number of synopsis and bio-data, the application is liable to be rejected at the screening stage.

Indian Council of Agricultural Research

FAKHRUDDIN ALI AHMED AWARD FOR AGRICULTURAL RESEARCH IN TRIBAL AREAS FOR THE BIENNIUM 1982-83.

Nominations are invited for the Fakhruddin Ali Ahmed Award for agricultural research in tribal areas for the biennium 1982-83. Two prizes of the value of Rs. 10,000/- (Rupees ten thousand only) each in cash or kind or both will be awarded for outstanding original research carried out in the tribal areas in the field of agricultural sciences and animal sciences including fisheries.

All research workers engaged in research in agriculture, animal husbandry, fisheries and allied sciences in tribal areas (tribal areas for this purpose are those notified by the Ministry of Home Affairs, Govt. of India) shall be eligible for the award. The results of research achieved/contributions made during the five years preceding the year of the award shall only be considered for the award In the case of claim based on evolution of new varieties/strains the final trials should have been completed within five years preceding the year of the award.

Nominations can be made, amongst others, by the Vice-Chancellors of the agricultural universities or other universities which have a faculty of agricultural or biological sciences, Directors of research institutes including Principal of agricultural and veterinary colleges, Presidents of scientific societies, academies and heads of principal scientific establishments in the country such as Council of Scientific and Industrial Research, Bhaba Atomic Research Centre etc. Each nomination for this award should be accompanied by a detailed statement of work and attainments of the nominee and a reasoned justification for the nominations together with the reprints of publications or other supporting data. Also, a certificate of residence in the tribal area where the work was done obtainable from Head of the Institutes, should be appended. It is emphasised that the award is intended for recognising outstanding research carried out in *tribal areas* and hence the scientist(s) concerned should have lived and carried out the research in any of the tribal areas notified by the Ministry of Home Affairs.

The last date for receiving nominations/applications is *30th April, 1984*. The last date for candidates in the Andaman and Nicobar Islands, Lakshadweep States/Union Territory in the North Eastern Region, Ladakh Division of J&K State & Sikkim is *16th May, 1984*. Four copies of the nominations on the prescribed proforma for the award should be sent in a sealed cover marked 'Confidential' to Shri K. S. Krishnaswami, Additional Secretary(A), Indian Council of Agricultural Research, Krishi Bhawan, New Delhi-110001. The copy of the proforma can be obtained from him by sending a self addressed envelope in the size of 27 cm × 12 cm. Nominations received without four sets of reprints of publications are liable to be rejected at the scrutiny stage.

Indian Council of Agricultural Research

HARI OM ASHRAM TRUST AWARDS FOR THE YEAR 1984.

Nominations are invited for the Hari Om Ashram Trust Awards for the year 1984. Three awards of the value of Rs. 10,000/- each in cash or kind or both are given every year for outstanding original research, fundamental or applied, including inventions, discoveries etc. leading to results of practical value in any field or subject within the purview of research in agricultural sciences, forest farming and social forestry and animal sciences (including fisheries).

All scientists engaged in research in the fields of agriculture, forest farming and social forestry, animal husbandry and allied sciences in India shall be eligible for the awards. The results of research achieved/contributions made during the five years preceding the year of the award shall only be considered for the awards. In the case of claims based on evolution of new varieties/strains, the final trials should have been completed within five years preceding the year of award.

Nominations can be made amongst others by Vice-Chancellors of agricultural universities or other universities having faculty of agricultural or biological sciences, Directors of Research institutes including Principals of agricultural and veterinary colleges, Presidents of scientific societies, academies and heads of the principal scientific establishments in the country.

Nominations for the awards should be supported by a statement of work, achievement accomplished or performed by the candidate who is being nominated and a reasoned justification for the nomination together with reprints of publications or other supporting data.

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Indian Council of Agricultural Research

RAFI AHMED KIDWAI MEMORIAL PRIZES FOR AGRICULTURAL RESEARCH FOR THE BIENNIUM 1982-83

Nominations are invited for the Rafi Ahmed Kidwai Memorial Prizes for Agricultural Research for the biennium 1982-83 carrying an amount of Rs. 10,000/- (Rupees ten thousand only) in cash or kind or both, a citation and a certificate.

The award is given once in two years to Indian scientists for outstanding research, fundamental or applied, including inventions, discoveries, etc. leading to results of practical value in any field or subject within the purview of research in agriculture, animal husbandry and fisheries, including agricultural economics, agricultural statistics and nutrition. Only results of researches/contributions made during the five years preceding the year of award shall be considered for the award. In the case of claims based on evolution of new varieties/strains, the final trials should have been completed within five years preceding the year of award.

Nominations can be made amongst others by Vice-Chancellors of agriculturals universities/general universities with faculties of agricultural or biological sciences, Directors of research institutes, including Principals of agricultural and veterinary colleges, Presidents of scientific societies and academies and heads of the principal scientific establishment in the country such as CSIR, BARC etc.

Nominations for the award should be supported by a statement of work, achievement accomplished or performed by the candidate who is being nominated and a reasoned justification for the nomination together with reprints of publications or other supporting data. In all matters, decision of the Council shall be final and no correspondence on this account will be entertained.

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ICAR AWARDS FOR TEAM RESEARCH FOR THE BIENNIUM 1983-84.

Nominations are invited for ICAR Award for Team Research for the biennium 1983-84. The award is given once in two years to interdisciplinary teams of research workers for outstanding research work in the field of agriculture including agricultural economics and statistics, animal husbandry and fisheries in the form of a scroll of honour and a medal to each member of the award winning team.

All scientists engaged in research in the field of agriculture, animal husbandry and fisheries sciences in India shall be eligible for the award. The award of each prize shall be made for notable and original interdisciplinary research both fundamental and applied as reflected in books, monographs, papers or other forms of published account of outstanding research work, inventions or discoveries. In the case of contributions like new crop varieties or new breeds of animals at least 3 years data on the performance of the strains will have to be provided. The results of research achieved/contributions made by the teams should be during the five years preceding the year of award.

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Applications are invited for Dr. Rajendra Prasad Award for the year 1984 for standard original books/manuscripts in Hindi on agriculture, including animal sciences and fisheries published/written between April, 1983 to March, 1984. Books written by more than one author can also be considered. Five copies of the books/manuscripts for the award may be sent in a sealed cover marked 'Confidential' to Shri K. S. Krishnaswami, Additional Secretary (A), Indian Council of Agricultural Research, Krishi Bhawan, New Delhi-110001, latest by *30th April, 1984* in a prescribed form obtainable from him. The last date for candidates in the Andaman and Nicobar Islands, Lakshadweep States/Union Territory in the North Eastern Region, Ladakh Division of J&K State & Sikkim is *16th May, 1984.*

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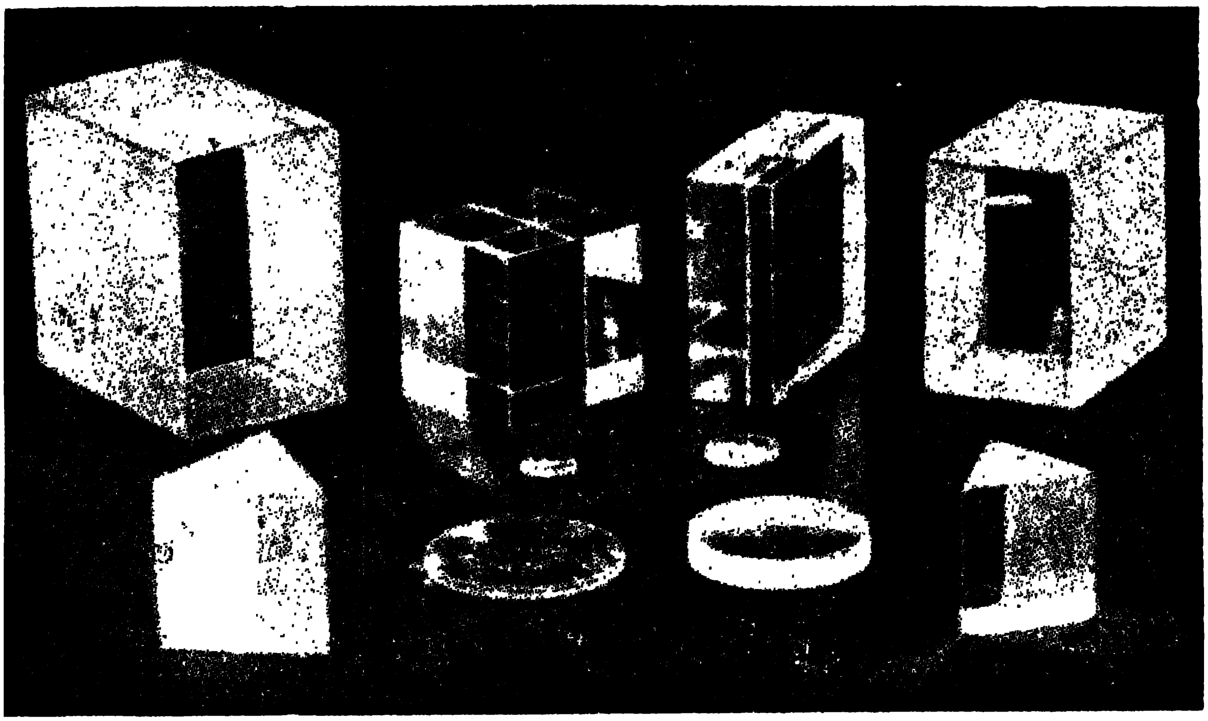

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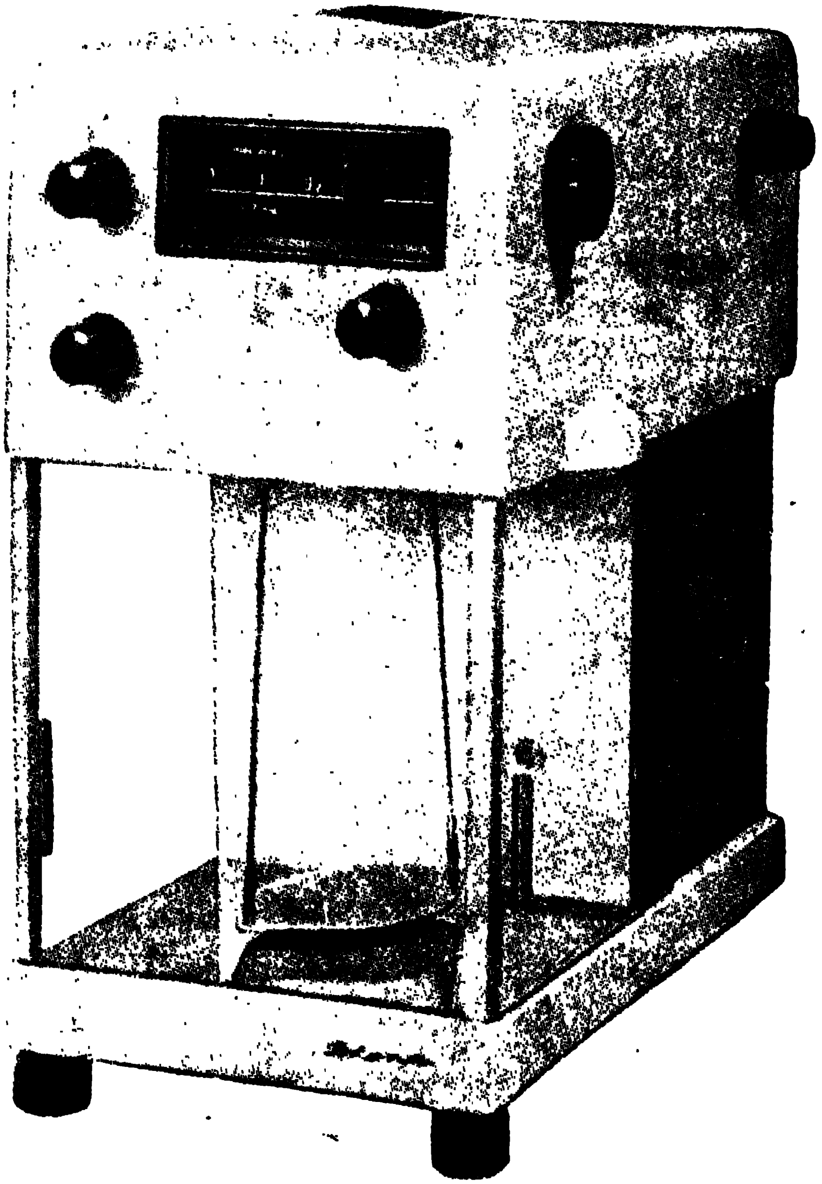

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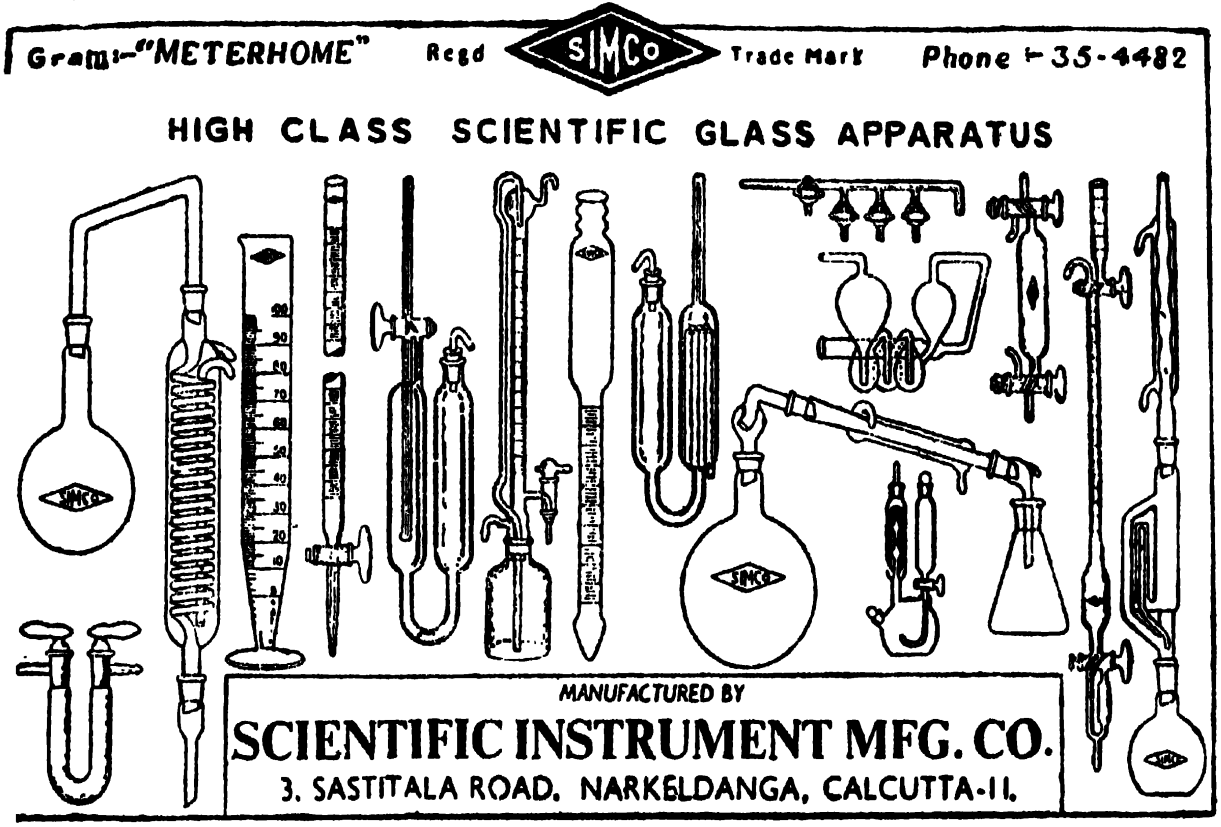

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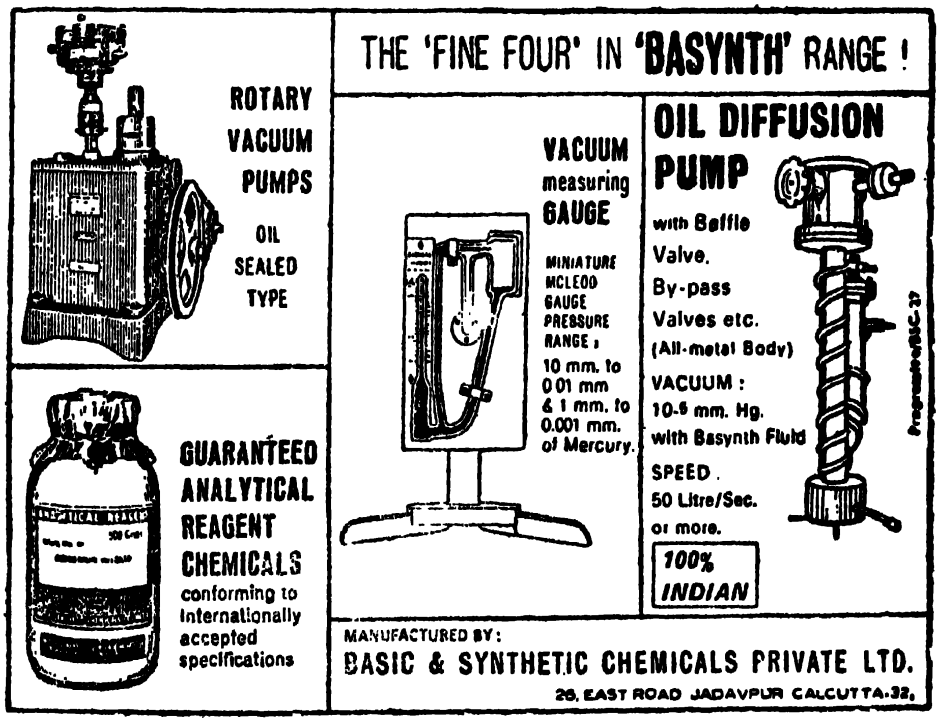

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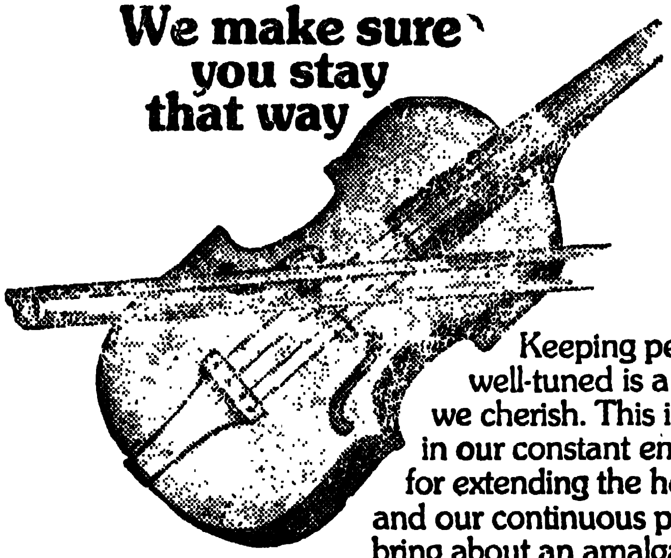

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SCIENCE & CULTURE

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NUTRITION

THE growing world population and the shortfall in food resources especially in the developing countries has caused great concern. The international agencies have blown up this awareness into acute protein shortage scare. The world Health organisation, the Food and Agriculture Organisation and UNICEF have constituted a Protein Advisory Group. However, health and nutrition, in general, is a very vexing subject in developing countries.

The protein scare has been played up by some interested scientists in our country to the extent of announcing that "protein malnutrition among many millions of Indian infants and young children below four years is causing irreversible brain damage leading to intellectual dwarfism that persists throughout life." Such statements have not been substantiated by scientific evidence, in spite of the fact that several seminars took place in recent times on the topic.

Under the circumstances several questions arise. Is there really a protein malnutrition in the country ? What are the reasons for this alarm ? Is there any effort to eradicate malnutrition ? If so, how effective is it ? General malnutrition is an old problem in India but the term protein deficiency has entered the controversy in the recent times, probably in the sixties. To speak broadly, this awareness in the world arose with the breeding methods employed in the USA in upgrading the quality and quantity of proteins in the maize. It is the extrapolation of such ideas in Indian context that became fashionable. In their enthusiasm to play with this new toy it was forgotten by many, to give a second thought whether that what is needed for America is suitable for India or not. A mad rush followed to meet the 'protein gap'. Doctors, dietecians, nutrition experts and the reading public took the tune in right earnest ; doctors-chambers and drawing rooms of society personal reverberated with the same sound of filling the protein gap. It was at such a time that Dr. P. V. Sukhatme, a nutrition expert and former Director of Statistics Division of FAO and Dr. C. Gopalan, a former Director-General of the Indian Council of Medical Research (ICMR) made an elaborate survey. Their data showed that there is no shortage of protein in the predominantly vegetarian cereal based Indian diet. In fact, the total protein supply was found to be, on an average, about 50 percent in excess of the total requirement. In general, protein malnutrition appears to be wide spread in economically handicapped sections of the population because of insufficient food intake which is the result of their low purchase capacity.

In the Indian diet the major source of proteins is cereals and pulses. A combination of cereals and pulses complements each other in the overall protein requirement. It is well known that pulses are rich in lysine which is the major deficient essential amino acid in the cereal proteins. Pulses are a poor man's diet in India and a quantity of pulses as small as one tenth of the cereals helps to make good the deficiency of lysine.

Because of these dietary habits the protein intake does not remain inferior to other socio-economic groups. Thus the bogey of protein deficiency raised in India is directly due to certain vested interests of foreign countries who are keen to develop and sell their technologies at the cost of poor countries. And the cue has been taken, without even a second thought, by some doctors and scientists without proper perspective of the problem.

The knowledge of the level of general nutrition in the population is essential to monitor and maintain the health of a nation. A couple of years back Dr. P. S. Sukatme, the nutrition expert sparked a stir in the nation by his finding about important methodological problems of measuring the extent of undernutrition and malnutrition in a population. He concluded that the actual level of undernutrition in India is only 15 percent instead of 40 per cent as estimated in earlier studies. Ofcourse, even taking the lower estimate, the absolute numbers of persons involved are still staggering and demand attention.

Health, nutrition and survival aspects of a population are not the concern of only medical analysis but requires greater involvement of other disciplines too, especially social sciences. Though it is true that nutritional in-takes of the population in India have improved considerably and is not susceptible to the periodic fluctuations which plagued earlier times, there is still a large and discernible patch of malnutrition and undernutrition, which requires subtle handling by social scientists. It is true that considerably higher proportion of the population can hope to survive into and beyond adulthood, it is not really clear that those who survive are really more healtheir than their counter parts in the earlier years. The resurgence of several of the previously controlled diseases and the susceptibility of the population to these and new infections, cast doubt on the level of nutritional nourishment received. This calls for a great need for methodological and measurement studies to make reliable assessment. What is needed is the studies of differentials in under-nutrition, morbidity and mortality.

An approach to these studies can be, made by abandoning the assumption of homogeneity of population. Not only the biological characteristics like age and sex have to be taken account of, but also the social, economic and cultural attributes of the population have to be properly considered. This is absolutely essential to identify the high risk groups in a situation where the resources for treatment are limited. Productivity and nutrition in the working class is another socio-economic differential to be studied, as it is important in any planning for the country. Whatever little investments are made in health care in India, based on incomplete information, they are appropriated by the more official family planning programme. What is necessary is a proper assessment of managerial and administration needs and improving the skills especially regarding programme delivery rather than programme planning itself.

We are slowly grasping the importance and immensity of child nutrition in the country by introducing the midday meal programme in the schools. There is much to be gained by other states from Tamil Nadu as regarding effective management of such programmes. With proper survey inputs and evolution of reliable methodology of measurement it should not be difficult to initiate general health care programme side by side with the family planning programme, since the necessary infra-structure and keen interest to execute such a programme exists in the country. ☐

B. B. Baliga

VEGETABLE PROTEINS—A STRATEGY FOR THE FUTURE

SATISH JINDAL and C. M. BHAT*

The development of vegetable protein food needs to be widely encouraged. They are as good as animal protein foods when appropriately prepared and are better suited to feed mankind in a future of dwindling energy resource, increasing costs and permanent population pressure.

WITH the increase in the global population, ways and means of the supply of protein requires the utmost attention. It has been estimated that by the end of this century, there will be approximately six billion people on the face of the earth. To cope up with their protein requirement, a twofold increase in the supply of vegetable proteins and a four-fold increase in the supply of animal proteins would be needed to have the same level of nutrition which we have at present including the sub-optimal protein level in many parts of the world. Most experts feel that to expect such an increase in the supply of animal protein is unrealistic. This conclusion has been drawn considering the cost of production, religious and cultural practices associated with the consumption of protein from animal sources and the expectation that man and beast will ultimately be forced to compete with one another for the same living space and the same available food supply. Moreover, with the increase in the living standards, man increases his protein intake more than his physiological needs and he switches from cheap vegetable protein to expensive animal protein consumption. The net result of this progression that more and more vegetable crops are grown not to feed man but to feed domestic animals with a very low efficiency and this ultimately leads to a paradoxical situation, the rich gets too much protein and the poor less and less. We are thus forced to concentrate more upon the protein from the vegetable sources as they are to become the major protein sources in future, particularly in the developing countries like India.

Amongst the major vegetable protein sources, cereals and pulses are the major ones. In a survey conducted in 1974, it has been observed that cereals alone are responsible for about 70% of the protein production from plant sources and that the pulses and oilseeds constitute the other major fraction[4]. Pulses contain 20-30% protein which is more than double the amount present in cereals (7-12%). India has the highest area for cultivation of the pulses in the world but because of more price and higher yield, cereal cultivation is gaining popularity[6]. During the past few years, with the release of high yielding varieties of cereals, the cultivation of the pulses has decreased considerably with the result that the per capita availability of pulses has gone down. Research at Agricultural Universities has shown that with the development of high yielding and short duration varieties of pulses, it should be possible to grow cereals and pulses as complementary rather than competing crops.

Protein-rich sources like cereals and pulses are, however, associated with certain disabilities regarding the quality of their protein which is mainly determined by the level of essential amino acids present in the protein. The cereals are known to be inherently deficient in lysine and pulses in methionine. Biological value of these proteins is, therefore, considered to be inferior to those of animal proteins. This fact has been greatly over-emphasized in the past, since it is relatively easy to overcome this drawback by mixing them in an appropriate manner. For example, corn is high in methionine and beans are rich in lysine and when eaten together the two foods provide a protein as high in biological value as that of meat protein. Such all-vegetable protein diets have not only been successfully used in the child-feeding programme but have also produced dramatic cures of the disease of protein malnutrition known as kwarshiorkar.

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Potatoes and green leaves are the other good protein sources. Potatoes contain 10-12% crude protein, 50% of it being in the form of small peptides and free amino acids. Although potato has a protein concentration comparable to that of cereal grains but its protein quality is much better than that of cereals and is comparable with an animal protein[4].

Green leaves are the highest producers of protein in a plant and supply protein to the other tissues including the seeds which are subsequently used to nourish humans and animals. The presence of structural material in leafy plants, like cellulose and lignin which are largely indigestible by man, has led to the development of methodology to produce leaf-protein concentrate for incorporation into human food. Leaf protein concentrates for human nutrition are manufactured in Hungary and France and new factories are coming up in U.S.A., Denmark and Great Britain[5].

In the present era of global energy crisis, the vegetable protein production is much more profitable. The energy ratio[2] (Energy produced in terms of protein production per unit energy consumed) for vegetable protein production is always greater than 1, e.g. energy ratio for production of corn in African countries is as high as 35.0. With the increasing mechanization of agriculture, the ratio drops rapidly, but does not fall below 1, whereas for animal foodstuffs, the ratio is of the order of 0.4 to 0.1, demonstrating the high inefficiency of animal protein production.

An important disadvantage which, however, cautions the use of the vegetable proteins is the presence of certain anti-nutritional factors in the plants. There are a variety of chemical substances which are known to exert a deleterious effect when ingested by men or animals. The anti-nutritional factors reported to be present in the plants are trypsin inhibitors (inhibit the digestive enzymes), haemagglutinins (reduce the digestibility), goitrogens (cause enlargement of thyroid), cyanogens (cause cyanide poisoning), saponins (soap like substances hemolysing the red blood cells); substances producing lathyrism (neurological disorder), substances inducing favism (hemolytic anemia mainly due to ingestion of fava beans), allergens (cause allergic reactions), phytate (inhibits mineral absorption and other toxic factors of mold origin like mycotoxins[8]. Amongst these, the trypsin inhibitors and haemagglutinins which are protein in nature are of major importance in most of the pulses and cereals. At this point, the following question may be asked : if toxic substances do, in fact, exist in plant foodstuffs commonly consumed by man, why are not their effects manifested more frequently in the population ? It would appear that through trial and error, man has not only learnt to avoid those foods which produce immediate ill effects but he has also devised ways and means of eliminating them. Fortunately, cooking and other common means of preparation have proved to be effective in destroying many of these antinutritional factors in plant foods, e.g. the trypsin inhibitors and haemagglutinins are destroyed by cooking and are of thus limited significance in human diets. It is also true that these natural intoxicants are generally present in such small amounts that under conditions of normal consumption their toxic effects are not revealed, possibly because the normal detoxification mechanisms of the body can get rid of them. It is conceivable, however, that abnormal pattern of food consumption might bring to the surface, toxic manifestations which would not otherwise be apparent. A good example of this is the periodic eruption of lathyrism (characterised by spastic paralysis of the legs as a result of neurological lesions of the spinal cord degeneration) due to consumption of certain varieties of *Lathyrus* species e.g. *Khesari Dal* in certain parts of India especially in Rewa and Raipur districts of Madhya Pradesh. During Summer of 1974, an out break of an epidemic of lathyrism was reported spread over 160 villages in the region. This constituted an overall prevalence of lathyrism in 16 per 10,000 population[1].

At last, the important practical problem with the utilization of plant proteins should be mentioned, namely the low appeal of vegetable protein to the modern man. This has led to the manufacture of plant protein-textured foods which have a taste resembling that of meat. However, it is not considered to be a very exciting approach. Rather, we should start using, as starting point, the age old traditional dishes, for example those prepared from soybean, which have evolved slowly by a sort of trial-and-error process and are highly nutritious and palatable. For example, three types of traditional soya preparations from Japan : Tofu, a preparation in which the soya protein is precipated by calcium salts ; Yuba, a dish in which the protein is coagulated by heat and Soya sauce, and a condiment in which protein is hydrolysed by enzymes are of very good taste and contain good-quality protein. This illustrates the traditional artesanal practices that should become the basis for new technologies.

In conclusion, it can be suggested that food technology and tradition should meet together to give a new impetus to the development of vegetable protein foods to help mankind in a future of dwindling energy resources, increasing costs and permanent population pressure. ☐

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RICE PROTEIN

RAMESH CHANDRA PARIDA*

According to the special report of the Indian Council of Medical Research[1], in India 72.3% of protein is derived from cereals, as compared to 16.2% from pulses, 3.2% from vegetables and fruits, 2.3% from milk, 4.2% from fish and meat and 1 9% from condiments etc. The picture

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is not much different in most of the Afro-Asian Countries, rather, some of them are more dependent on cereal than India. Among the cereals, rice (*Oryza sativa* L.) serves as a staple food for more than half of the World's populations. Therefore, although it is a relatively poor source of protein, rice protein constitutes a major part of the total global protein consumption. Besides, in quality it is also superior to most other cereals.

Protein Content & Chemical Composition of Rice grain

Cereals are essentially starchy substances containing relatively less protein. Rice is the poorest cereal, so far as the protein content is concerned. It contains only 6% to 8% protein in average, where as, wheat contains 8% to 12%, barley 8% to 9%, oats 9% to 10%, rye 8% to 9%, corn 10% to 15%, bajra 11% to 16% and sorghum about 11.5%. Besides protein and starch, lipids, vitamins, minerals etc. are also present in rice in minor quantities. The composition of rice varies widely, not only in different varieties, but also, in the same variety grown under different conditions. However, an average composion of the Indian varieties is as follows[2,3].

Protein—6% to 8%, Fat—1.4% to 2.4%, Ash—1% to 1.5%, Carbohydrate—80% to 90%, Crude fibre—0 2% to 0.84%; reducing sugar—0.4% to 0.45%, available lysine—2% to 2.5%, Phosphorous (as P_2O_5) - 0.2% to 0 76%, Potassium (as K_2O) about 0.2%, Calcium (as CaO)—0.17% to 0.25%, Magnesium (as MgO) about 0.2%, Iron (as Fe_2O_3) —0 013% to 0.016%, Thiamine—1.00 to 5.4 $\mu g/g$, Niacine—11 to 52 $\mu g/g$.

Rice-bran and embryo are very rich in protein, but, are usually lost during milling[4,5]. The embryo, which is about 2% to 4% of rice grain contains 35% to 37% Oil*, 30% to 32% crude protein**, the rest being carbohydrates and other-things.

Similarly, the defatted rice bran has been found to contain about 14.71% protein, 1.28% amylose, 18.04% starch, 45 (mg%) calcium, 49 (mg%) iron; 1.17 (mg%) potassium, 3.56% phosphorous and 4.8% silica. Raw rice-bran contains about 16 2% oil.

In recent years new hybrid varieties have been developed in various research centres around the world, which have remarkably high protein content. Some such varieties are recorded in the table below[6].

TABLE 1

Name of the variety	Percentage of protein
Padma	12.80
Kanchi	11.38
IR-8	10.50
Nayagarh	11.05
Korn	15.98
Chowsung	16.15

Nutritional Value of Rice Protein

Table 1 indicates the percentage of protein in some of rice varieties. Unfortunately, all the high protein containing rice varieties suffer from certain major shortcomings. Not only their yield is poor, but also, they are more susceptible to adverse climatic conditions, diseases as well as pests and as such, can not replace the low protein containing traditional varieties. Therefore, inspite of those, rice continues to be a poor source of protein. However, this is compensated to an extent by the fact that in quality rice protein, especially, that of the low protein lines, is perhaps the best among the cereals[7,8]. It contains the essential amino acids, especially, lysine, the most limiting one for the cereal proteins, in higher quantity. The studies of its essential amino acid index (EAI), biological value (BV), protein efficiency ratio (PER), net protein utilization (NPU) value etc., have proved its supremacy over other cereal proteins. A comparision with wheat, a relatively richer source of protein and the only viable alternative to rice as food, makes the points clear.

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* Measured in moisture-free basis.

**Measured in both moisture and oil free basis.

TABLE 2

	PER (in rats at 11% protein)	BV (in rats at 11% protein)	NPU	Lysine g/16g.N
Rice	1.67	63.1%	66.2%	3.49%
Wheat	0.79	49.1%	59%	2.55

Composition of Rice Protein

Rice protein is composed of 4 soluble fractions : (1) Albumin, the water soluble fraction, (2) Globulin, the saline soluble fraction, (3) Prolamin, the alcohol soluble fraction and (4) Glutelin the alkali soluble fraction. The glutelin constitutes about 75% to 80% of the total rice protein, whereas, albumin and globulin constitute about 8% each and prolamin, less than 5%.

For the extraction of the various protein fractions, usually, finely powdered defatted rice is fist stirred with 5% NaCl solution for several hours to dissolve both albumin and globulin in it. Then on dialysis of the extract against water, globulin, the water insoluble protein gradually precipitates, leaving only albumin in solution. This method is preferred for the extraction of albumin over extracting it directly with water, because, it ensures better extraction. Since both albumin and globulin are extracted together with salt solution, those are referred to as salt soluble proteins. Then the remaining rice powder is treated with 80% ethanol for the extraction of prolamin and with 0.1 N NaOH for the extraction of glutelin.

These fractions themselves are not homogenous. They are found to have contained a number of subfractions. As for example, globulin contains a good number of enzymes which play wide range of roles during the grain development as well as during germination. At present, various types of globulins, labelled as α-, β-, γ- (γ_1, γ_2, γ_3, γ_4..... etc.) δ- have been isolated and characterized. Similar are also the cases with albumin, prolamin and glutelin. Polyacrylamide get electrophoresis indicates that both albumin and globulin contain 10 to 16 subunits of different molecular weights, where as, prolamin and globulin contain about two subunits each.

The amino acid compositions of these 4 fractions have been separately determined, which show that they differ widely in both essential and non-essential amino acid patterns[8,9]. Lysine, the most limiting essential amino acid in cereals is found to be more in the salt soluble fraction, whereas, it is the least in prolamin. That is why, this fraction has the lowest nutritive value. The rice protein contains very less prolamin, but, in other cereals such as wheat, maize etc. it constitutes as much as about 50% of their total protein content. Therefore, such proteins are inferior in quality to rice protein.

Changes in protein & amino acid composition

All the four fractions vary in their proportions during the development of rice grain[10-12]. Up to 12 days after flowering the salt soluble proteins progressively increase and thereafter, go on decreasing with grain maturity. The level of globulin always remains at twice the level of albumin from 7 days to 12 days after flowering. Albumin decreases from about 16% of the total protein in the grain at 2 days after flowering to about 7% to 8% in the matured grain and globulin decreases from about 17% to about 8% of the total protein during the same period, whereas, glutelin-prolamin fraction increase from 67% of the total protein at 2 days after flowering to about 86% at maturity.

During the grain development the levels of many essential and non-essential amino acids change significantly. Lysine and threonine, the most limiting amino acids for cereals, progressively decrease during grain protein accumulation as the proportion of salt soluble protein to total protein decreases and that of glutelin protein increases. Tyrosine increases continuously during the grain development, methionine increases only from 2 to 4 days after flowering, whereas, cysteine does not change during ripening. Among the non-essential amino acids, arginine and glutamic acid levels increase during grain development, but, aspartic acid, glycine and alanine decrease. No definite trend is observed in the other amino acids during this period.

The changes of amino acid composition of rice protein during grain development can be partly explained by the decreasing contribution of salt soluble proteins and the corresponding increase in glutelin and prolamin. These fractions differ widely in their amino acid compositions and thus, it so happens that besides, the amino acid grams of the salt soluble proteins themselves also change. This is because, the different enzymes, which constitute the salt soluble proteins, appear in sequence during the grain development. Another contributing factor is that the non endosperm parts of rice are synthesised earlier than the endosperm in the developing rice grain.

Effects of storing, processing and cooking on rice protein

After the harvest rice is usually stored for a pretty longtime and is then processed and cooked before consumption. Therefore, studies on quantitative as well as qualitative changes of rice protein during these processes are important.

The total protein content of rice practically remains constant during storage under ordinary conditions, provided its moisture content does not exceed 15% and is not affected by insects or otherwise[13]. If the moisture content is more the protein content decreases[14] and non-protein nitrogen as well as free amino acids increase. More the percentage of moisture, more pronouced is this effect. This is due to the action of contaminant micro-organisms capable of hydrolysing protein. It has been established that the growth of one such, named "Fusarium chlamidosporium" on rice results in an increase in the number and concentrations of free amino acids. Therefore, storage under poor conditions, which help micro-organisms to grow, also increase the free amino acid contents at the cost of protein. At higher moisture levels, deformation of cells of the aleurone layer and starchy parenchyma is observed, decreasing the quality of rice.

Even when stored under proper conditions, various fraction of rice protein undergo significant changes leading to decrease in all soluble fractions[15,16] apparently due to denaturation, proteolysis and oxidation. The greatest quantitative losses are those of glutelins, but, when expressed as percentage of the original fraction the greatest losses are those of albumins and prolamins. The change in albumins could be of significant interest as regards nutritive value, cooking quality and stability of rice under storage, since this fraction is one that contains more lysine and it is richer in —SH and —S —S groups.

If stored for longer, say 2/3 years or more the total protein content of rice decreases and digestibility diminishes. The most valuable fraction albumin is more concentrated in the periphery of the rice grain. Longer storage affects it.

The accumulation of ammonia, which increases with the increase of storage period, percentage of moisture and poor storing conditions is found to be one of the major factors responsible for the loss of viability of the grain.

Analysis of flours obtained by successive abrassive millings of rice have shown that concentrations of protein and other nutrients are greater in outer layers of the kernel and decrease progressively towards the centre[17]. Distribution of crude fat is uniform, whereas, proportion of starch increases from periphery to core. Successive extracts of each flour with water, 5%

sodium chloride, 80% ethanol and 0.1 N sodium hydroxide solutions show distinct qualitative differences among protein components of flours.

Proteins of outer layers considerably greater proportions of albumin and globulin fractions that those from the central portions and from the original whole kernel.

Prolamin shows little variation, glutelin content is the smallest in the proteins of outer layers.

Amino acid analysis of various fractions of rice flour show that outer layers containing more albumins and globulins are richer in lysine and other essential amino acids. Therefore, polishing of rice causes loss of those.

Parboiling has a better effect on the nutritional value of rice protein. Not only it increases the digestibility but also, causes a slight increase in protein content. An increase of albumins and decrease of both globulins and prolamins are resulted because of it. The glutelin fraction remains by and large unaffected.

It has been observed that on cooking in plain water there is a loss of about 6.2% of lysine and 3.4% of threonine[18,19], but, this loss is considered to be negligible. Besides, it also reduces digestibility. Proteins of raw milled rice has 100% digestibility in growing rats, whereas, cooked rice has only 85% in pre-school children. However, cooked rice has a higher biological value and significantly higher net protein utilization value than raw rice. Therefore, cooking does not have any over all adverse effect on the nutritional value of rice protein. The protein which becomes denatured or resistant to digestion during the process are of poorest nutritional value and thus, does not make much difference. But, rejection of water with which rice cooked, especially, if it is salt water, a considerable loss of soluble proteins results and as such, should be avoided. ☐

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NOTES & NEWS

Science and Technology in Indian Culture

Histories of science and technology which have so far been written do not adequately represent the interaction of science and technology with culture, social values and philosophical ideas on the one hand and the economic structure and economic development in any given social system on the other. Further, they are highly Eurocentric and leave out the development of science and technology of non-European culture areas and the latter's contribution to the world stream of knowledge and technological development.

Since the Second World War, Prof. Joseph Needham's contributions to the understanding of the science civilization of China, and the studies in history of science and technology in Japan, have brought out the extent of development of science and technology in the respective countries. Recently, the work on science and technology in Islamic culture area has brought forth the richness of contributions made during the medieval period.

Somehow or other, the development of science and technology in India throughout her history, however, has not been adequately represented. In the absence of the scientific and technological component, there has been an incomplete understanding of India's culture and civilization and their contribution to the enrichment of world culture. Further, the introduction of science by the British in India is considered to be the beginning of science and technology in India and there is much dependence on the literature produced in UK and USA on the historical and social perception of science.

In order to develop a proper historical perspective and bring to sharp focus the development of science and technology in India and their relations with society, her culture, social values, philosophy and economic development, the National Institute of science, Technology & Development Studies has initiated a significant effort and is organising a major programme under the title: "Science & Technology in Indian Culture".

The programme is divided into the following:

(i) Science and technology in ancient India (from the earliest times to the beginning of AD 12th century): This will trace the development of science and scientific thought in India in the perspective of the history of global science with the awareness of the complex interconnection of science with social organisation, technology, craftlore and belief system—the last as embodied in magic, folklore, religion, philosophy and jurisprudence. The purpose is not only to discern comparable contributions of Indian scientists with contemporary scientists in other civilizations but also to seek answers to the following queries. What did the scientists in India contribute to the mainstream of world science? What did the Indian scientists receive from this mainstream? Where and why did the Indian scientists fail to be enriched by the scientific activities in other civilizations, with which India had relations through trade, commerce, political and religious missions? Other factors which caused the decline of science in India will also be studied. There is also a project to study in depth of the Indian tradition of maritime activities, navigation and nautical sciences in ancient and medieval periods.

(ii) Science and technology in medieval India (AD 1200-1800): In this theme, particular interest is being taken as regards the impact of the Central and West Asian Science on the Indian sub-continent. In addition to the development of science and technology, which was part of the Indian tradition, the scientific ideas have percolated to the Indian society through Arabo-Persian scholarship. It is believed that this scholarship became a part of the Indian culture. How far this process has been successful will be investigated. The bulk of the historical literature for this period dealing with scientific and technological work is available in Arabic, Persian and Sanskrit languages. A few important texts have been selected for critical examination. Historical reconstruction of the period will be made to highlight the interaction between the development of science and technology in the various sectors of society. It will include the study of science and technology subject-wise interdisciplinary development over different periods in medieval India. Finally, it will draw a synoptic view of the development of science and technology as a component of the cultural system. As a part of this study an effort is also being made to study the introduction of Indian science and its impact on Arabic scientific literature.

(iii) Science and Indian response in colonial era : The introduction of western science and technologies in India specifically with reference to the imperial motives and needs is being studied. While the establishment of various scientific surveys and explorations and introduction of steam navigation, electric-telegraph and railways, etc. had some positive effects helped the British in the negative assessment of Indian science and educational traditions created a socio-psychological tension on the Indian mind. Here the objective is to analyse the way in which the Indians reacted to the introduction of western science during the British rule, and to assess the impact it had on the emergence of scientific institutions, technological projects and industrial development. The study of this period will be spread over two phases covering the East India Company (1765-1857) and the Raj (1858-1946).

(iv) Science and technology in post-independent India : The evolution of science policy in India is being subjected to an indepth study. There has been a major effort to try to put together the information on science and technology development which is taking place in India since independence. In this respect, considerable work has already been done particularly with regard to the evolution of science policy as seen from the speeches and policy statements on science and technology of Jawaharlal Nehru and Mrs. Indira Gandhi.

In this programme, the main thrust is being given to the development of research capabilities for achieving the take-off stage for developing research themes and studies. Presently, there are two main difficulties in the development of research capabilities. Firstly, there are only a few scholars in the country who have the required expertise in the study of history of science and technology. The young historians are not much attracted to this field as it is not a traditional area of research. Two eminent historians, one conversant with the ancient period and the other with the medieval period, have been appointed as guest scientists to develop capabilities among the young scholars at Calcutta and Lucknow respectively. Secondly, the scholars are required to have a fresh look at the historical development of science and technology in India. Also, there are constraints as to the access to the basic sources for evidence. The opportunities for access to such resources are to be developed through translation from classical languages and sufficient bibliographical work. The sources in Sanskrit, Persian and Arabic are being developed through translation of selected texts in English, Hindi and Urdu.

In addition, for the work on the history of science and technology in the Indian culture, a 'National Archives for Science and Technology' is being built up at the institute. It is intended to locate, identify and retrieve science and technology information contained in the hitherto unexploited archival sources of the country and keep them at one place so as to make them available to the scientists and technologists who would like to work on the development of science and technology in India as well as to the planners, policy makers, administrators, scientists and technologists through appropriate reference media. □

A. Rahman

Statues to honour Ramanujan

Two bronze busts of the noted Indian mathematician Srinivasa Ramanujan have arrived in India from Washington. They are the work of American artist Paul T. Granlund and were commissioned through an international project to honour Ramanujan.

According to Dr. Richard Askey, a mathematician who worked in one of the areas Ramanujan researched, the joint venture to honour Ramanujan, stemmed from a plea by his widow, Janaki Ammal, now in her 90's, that a statue of her husband which has been planned earlier in India be completed.

Dr. Askey began writing to scientists primarily in Canada and the United States to raise money to finance a suitable memorial. Money for two statues—one for display in Madras and the other for Ramanujan's wife has been provided by scientists and mathematicians around the world.

Among the scientists Dr. Askey contacted regarding the project was Nobel Laureate Dr. S. Chandrasekhar, who provided a passport photograph of Ramanujan as a model for the sculptures. He and his wife donated money for the statue.

One of the statues is now on display at the Indian Academy of Sciences in Bangalore and the second, gift to the widow of the late mathematician, was sent to Ramanujan Institute at T. K. University of Madras. The busts cost about six thousand dollars (Rs. 60,000). About 100 scientists contributed money and donations are still coming in. It is expected the surplus money will be given to deserving institutions in India. □

R. B.

Healing Park

A park, where patients are not prescribed to take medicine but advised to walk among certain species of trees for treatment, has been developed by Soviet Scientists.

Situated on the Yalta seaside, the park has been divided into seven therapy zones —each overgrown with ash trees or olives, Aleppo, Italian or Crimean Pines, Himalayan or Atlas Cedars.

Each zone in particular and all of them together have a most favourable effect on people's health who move there for treatment. The phytoncides they emit make people stronger and more vigorous. □

APN

Low-cost millet based beverage

The Central Food Technological Research Institute, Mysore, has developed a low-cost beverage from malted millets. The product dissolves easily in milk.

The millets used for making the beverage include *Echinochloa frumentacea*, *Eleusine coracana*, *Panicum sumatrense*, *Paspalum miliaceum*, *P. scrobiculatum* and *Setaria italica*.

The manufacturing process consists of preparing a syrup using millet and barley malt in equal proportion. Cocoa powder, milk powder and essence are added to the syrup which is then homogenised and dried in vacuum shelf-drier.

The product is expected to cost about Rs. 28 per kg which is much lower than the market value of commonly available food beverages. □

CFTRI News

New varieties of papaya and barley

The Indian Agricultural Research Institute has developed a new papaya variety, *Pusa Nanha* and two new barley varieties, P-402 and BHS-169. While *Pusa Nanha* and P-402 have been developed by the Regional Station, Pusa (Bihar), BHS-169 by the Regional Station, Tutikandi (Simla).

Pusa Nanha, a dwarf papaya mutant, evolved by gamma radiation, is a dioecious line with a height of only 100 cm. It is found to possess 100% uniformity. It fruits at a low height of 30 cm above the ground. The fruits are medium oval and the yield per plant is 18 kg. Though the yield per plant of the mutant is less, the yield per hectare is 50% more than the parental variety due to high-density population.

P-402, bred from the cross NP-21 × PL-4, is ideal for the rainfed conditions in the North-western Plains zone. It is short in stature, moderately resistant to both leaf and stripe rusts and has bolder grains with 48 g/1,000 kernel weight. On an average, this variety yields 7% more than the best control.

BHS-169, bred from the cross Kailash × Briggs, is suitable for cultivation in the Northern Hills zone. It is a six-row hulled variety with bold grains and has resistance to rusts, smuts and leaf diseases. It yields 15-20% more than the best control, *Himani*. □

IARI Newsletter

Resistance in tomato against nematodes

At the Division of Nematology, studies on biochemical resistance in tomato against the root-knot nematode *Meloidogyne incognita* indicated that the highly activated synthesis of mRNA occurred in resistant varieties at a relatively early stage of infection. The base-analysis of labelled RNA showed that increased RNA synthesis may arise due to the altered host metabolism in the resistant variety. □

IARI Newsletter

Kedarnath Laha Memorial Award

The Calcutta Skin Institute, Calcutta, invites thesis for the above award for an original work based on research studies conducted during the last five years in the field of dermatology by Scientists below 35 years of age. The award carries a scroll and a cash award of Rs. 1000/-. One copy of the thesis (non-returnable) is to be sent to the Secretary, Calcutta Skin Institute, 169 VIM CIT Scheme, Calcutta-700 054 by June 30, 1984. □

LETTERS TO THE EDITOR

Microcomputer-controlled Fraction collector

Separation of organic compouds, fatty acids, proteins, nucleic acids, amino acids, sugars and carboxylic acids can be done by distillation, crystallization, ultrafractionation, counter-current distribution, chromatography and fraction collection[1]. Of all these, chromatography and fraction collection methods are extensively used because of their precision in experimentation. Chromatographic columns are employed on a large scale in laboratory practice[2]. Since regular withdrawal of a large number of identical fractions is an operation exceptionally suitable for automation, a series of partly or fully automated fraction collectors have been developed[3-4]. The demand for fraction collectors and automated chromatography is increasing constantly as more attention is being paid to mechanization and automation of laboratory operations.

There are mainly four types of fraction collectors which are in use[5]. The first type of fraction collector is a constant time device, in which the collector changes test tubes after the fixed time interval. If solvent flow rates are maintained constant such a device is equivalent to a constant-volume collector. The second type of fraction collector is a constant volume device, which consists of a siphon arrangement to deliver a fraction of constant volume to each collector. The third type of fraction collector is a constant-drop device; in which a drop counter delivers a constant number of drops to each test tube[3]. Finally, the fourth type of fraction collector is a constant mass collector; in which the receptacles move on to a balance beam; which after a certain weight of the eluate has flowed in; gives the impulse for the exchange of test tube. This method is not widely used.

In all these types of fraction collectors, the time of collection is controlled by an external timer or time-relay preset, to give a suitable time interval. A relay is usually used to control the cassette. If the time of collection of the sample to be changed; then, the pre-set knob (usually a thumb—wheel switch) should be operated, manually.

In order to eliminate errors due to manual intervention in presetting the time, a microprocessor-based device is designed. This device is fully automated. The instrument described in our paper utilizes readily available; low-cost components like stepping motor, a cassette consisting of a number of test tubes and a 8080 microprocessor-based microcomputer.

A schematic diagram of the fraction collector is shown in Fig. 1. It mainly consists of (a) two stepping motors (SM 1 and SM 2), (b) interface circuit (driver circuit) and (c) an output port of microcomputer. The 8080 microprocessor-based microcomputer is used as the system controller. Movement of cassette and rotation of the control valve are accomplished by sending appropriate control signals to the stepping motors. Advantage is taken by dividing the eight-bit output port of the microcomputer into two channels; each of four-bit length. One of the stepping motors (SM 1) is connected to the first four bits and the other motor (SM 2) is connected to the next four bits. The shaft of SM 1 is connected to a cassette (a disc consisting of a number of test tubes to collect the fractions) and the shaft SM 2 is connected to the control valve of the fractionating column via an interfacing network (Fig. 2). The interfacing network consists of buffers (SN 7406) for isolation purpose and transistors (SL 100) for switching the motor windings. The diodes (BY 127) are connected in parallel with the motor windings (Fig. 2) to cutoff the back emf.

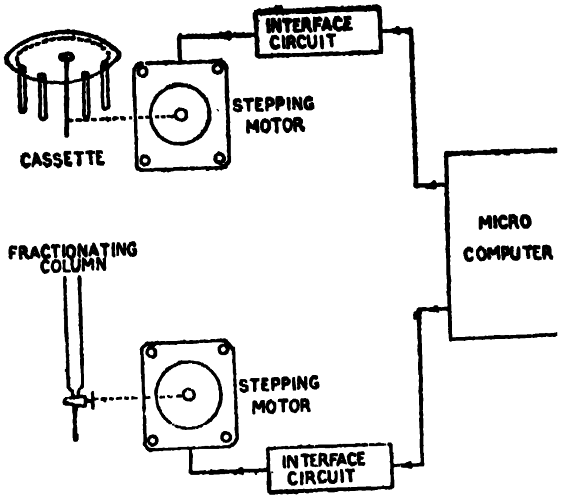

Fig. 1. Schematic diagram of microcomputer controlled fraction collector

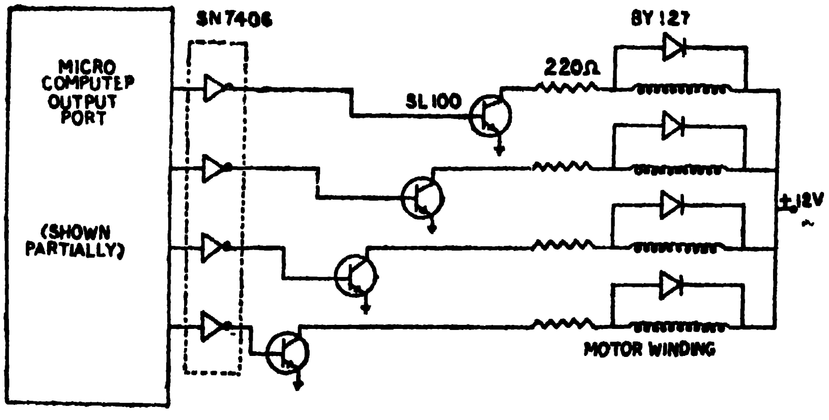

Fig. 2. Driver Circuitry

Rotations of the cassette and the control valve are accomplished by sending appropriate control signals to the driver network, which, inturn, processes the signals to the stepping motor windings. The signals needed to rotate the motor (stepwise) in clock-wise direction are given in Table 1.

TABLE 1 : Signals needed to rotate the motor in clock-wise direction (4 step sequence gives 1.8° rotation)

Step	Signal
1	0110
2	1010
3	1001
4	0101

These signals are entered in memory locations of the microcomputer. When they are takenout sequentially, the output rotates the stepping motor by 1.8°. The motor can also be rotated at a smaller stepping angle of 0.9° by using the sequence of signals shown in Table 2. A programme is developed to rotate the motor SM 1 connected to the cassette by n° in each step (where n is a multiple of 1.8°). As such, $\left(\frac{180^\circ}{n}\right)$, the number of test tubes are arranged in a circular form on a cassette. When the cassette (shaft of SM 1) is rotated by n°, the next collector will be directly under the fractionating column. Desired number of test tubes are arranged in a circular form at required angular spacings and suitable software is developed to get the required stepping angle. The other motor SM 2 is utilised to control the sample flow from the factionating column. A suitable programme is developed to open and close the valve for desired time intervals. The time of collection and time interval between successive collections are set by means of software.

TABLE 2 : Signals needed to get a stepping angle of 0.9° (8 step sequence gives 0.9° rotation)

Step	Signal
1	0100
2	0110
3	0010
4	1010
5	1000
6	1001
7	0001
8	0101

While the experiment is in progress; one can replace the test tubes in which samples

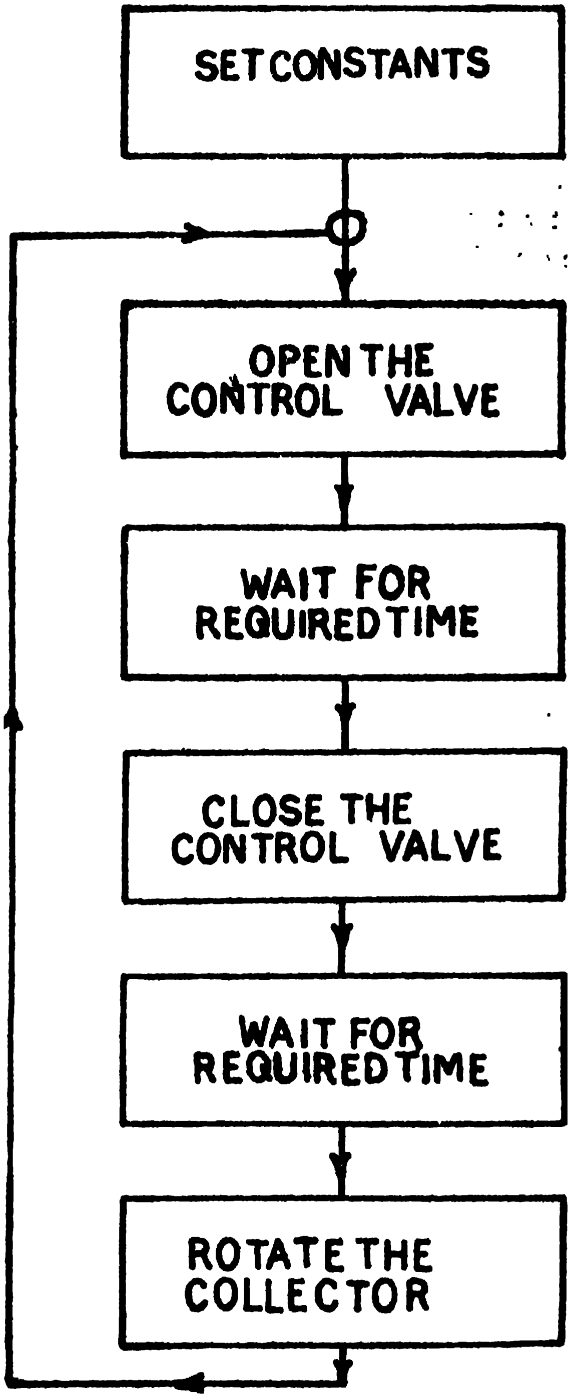

Fig. 3. Flow chart of the microcomputer controlled fraction collector.

are collected by empty ones to carry on the process, as the time interval between successive collections can be set by software. Otherwise, one can design the programme such that the system comes to a halt, when the collection of samples is completed in 'n' test tubes.

The flow chart of the fraction collector is shown in Fig. 3. The set constants involve setting a counter to output the data stored in memory sequentially. As a result, the motor whose shaft is connected to the control valve will be activated and the eluate flow in to the collector. The collection of fraction is governed by software time delay. After the eluate is collected, the valve will be closed and some time is allowed to collect the drops formed at the delivery point of the fractionating column. The collector is then rotated so that the next test tube will be directly under the fractionating column. The system will repeat itself. If the microcomputer is re-set, the system comes to a halt.

This system has a decided advantage that, if the reaction is not uniform, the time of collection can be varied from one collection to the other, using the software technique. In case of other types of fraction collectors, the time of collection should be adjusted from time-to-time, manually. Thus, a microcomputer-controlled fraction collector allows programming flexibility in the system.

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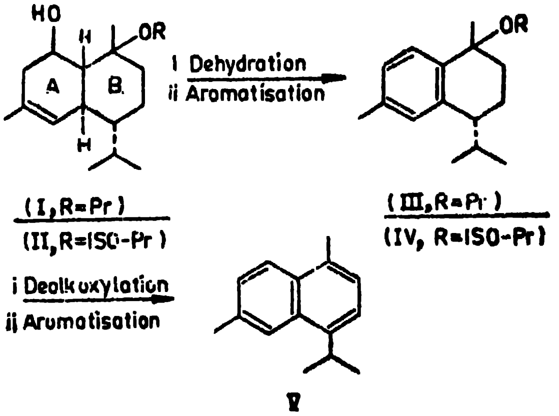
A novel dealkoxylation during dehydrogenation with D.D.Q.

In an attempt to dehydrogenate the hydroxy ethers[1] (I and II) to the corresponding cadalenes the reaction with Pd-C was carried out. The procedure requires high temperature (280-300°C) and this can bring about many undesirable changes that do not help in the establishment of the structure of the parent compounds. For example, cadinene is converted into 1,6-dimethyl naphthalene on vigorous treatment with palladium[2] whereas mild catalytic dehydrogenation and even prolonged treatment with selenium[3] yielded the expected cadalene.



V

Interestingly, when partial chemical dehydrogenation of compounds (I) and (II) was done with D.D.Q. in boiling xylene the products (III) and (IV) could be isolated by preparative t.l.c. from the reaction mixture. Compounds (III) and (IV) respectively, showed bands at 1070 cm^{-1} (C-O-C) and 1060 cm^{-1} (C-O-C). However, when a stirred mixture of 0.5 g of compounds (I) and (II) are separately heated with 1.5 gm of D.D.Q. in 25 ml of xylene at reflux temperature for 3 h, a single product cadalene, (V) $C_{15}H_{18}$, bp 155-158°/10 mm, was obtained in quantitative yield and it gave satisfactory elemental analysis. The dehydrogenated product showed as single spot on t.l.c. (silica gel G impregnated with symmetrical trinitro benzene) plates. The t.l.c. plates; when sprayed with a novel reagent[4] ($AsCl_3/AcOH$), gave respectively a light grey colour in the visible and violet fluorescence in the ultraviolet light. The infrared spectrum of compound (V) was also identical with that of an authentic sample of 1, 6-dimethyl-4-isopropylnaphthalene.

Formation of cadalene confirms the dealkoxylation of the propoxyl and isopropoxyl groups which represents a rare example of dealkoxylation during dehydrogenation with D.D.Q. Numerous cases are described in the literature where an aromatic methoxyl group survived dehydrogenation, both catalytic and chemical[5]. However, Kon and Ruzicka[6] observed in one case that the methoxyl group was retained only if the temperature of the selenium dehydrogenation was kept below 300°C. Cocker and his co-workers[7,8] reported two cases of elimination of an aromatic methoxyl group in the hydronaphthalene series with palladised charcoal. But nothing has been reported about the behaviour of propoxyl and isopropoxyl group during chemical and catalytic dehydrogenation. A probable mechanism is depicted in the equation.

Intermediates (III) and (IV) are formed due to the dehydration of the secondary hydroxyl group followed by aromatisation of ring A. Cadalene (V) is formed owing to dealkoxylation followed by aromatisation of ring B.

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Some studies on the leaching of dimethoate in soil

The problem of leaching of pesticides in soil is of varied importance. Once a pesticide is sprayed in a given plant or seed treatment is carried out, some part of it may enter the soil and may get leached due to rain water or when irrigation is done. The amount of pesticide which has entered the soil may then interact with the available micronutrients in the soil or it may enter the plants and can become toxic causing hazards problems. It is, therefore, very important to know how much of the pesticide has retained in the soil and further if the pesticide is degraded what types of the interactions can occur due to the degradation products. Keeping in view the above facts, it was considered important to carry out leaching experiments with dimethoate using acidic, alkali and normal soils.

The leaching experiments were carried out in the soil columns made from pyrex glass (3 cm diameter and 62 cm long). Columns were packed with the following soils up to 30 cm depth :

(a) Alkali soil from Hebbowal, Ludhiana ;
(b) Acid soil from Palampur (Himalayas) ;
(c) Normal soil from P.A.U., Ludhiana.

The total soil pore volume was filled with water to exclude air within the column. This was achieved by prior evacuation[1] and slow saturation with water from bottom to top[2].

The respective amounts of dimethoate leached at different times were collected and analysed.

The leachate which was collected at different time was taken and in it was added 1.0 ml of 1.4 N NaOH. It was then heated to 50°C on a water bath for about 10 min and in it was added 1.0 ml of sodium 18-tungstate reagent. 4.0 ml of urea cyanide solution was next added and the contents in the tube properly mixed. The solution was now heated to 50°C for about 30 min and the tube cooled at once in cold water. The absorbance was measured at 720 nm against the reagent blank using red filter.

After collecting the leachate as detailed above, the columns were allowed to stand and the water head was cut off. The leachates were collected in separate beakers till the last drop from the columns. These were analysed for dimethoate. The soil columns were next divided into five segments of 5 cm depthwise and soils in toto were collected separately from each column at 5, 10, 15, 20 and 25 cm. In all there were (a) 45 soil samples, (b) 63 water samples of leachate and (c) a leachate sample of residual water.

The water samples were shaken with acetone in a homogenizer and then filtered. The filtrate was cleaned up by the usual procedure and allowed to evaporate till one ml was left. Dimethoate was then determined colorimetrically. The results of analysis of leachates, soil segments and physico-chemical characteristics of the soils are given in Table 1. The analytical results have been given in Tables 2-6.

TABLE 2 : Leaching of dimethoate, Palampur (acidic soil) pH=5.7

Time	Concentration leachate in μ gm Amount added		
(min)	100 mg	150 mg	200 mg
15	10 μ gm	13 μ gm	18 μ gm
30	19	25	35
45	31	40	55
60	42	60	70
75	50	73	90
90	63	85	105
105	75	103	123

TABLE 3 : Movement of dimethoate in soil samples

Depth	Amount adsorbed		
(cm)	100 mg	150 mg	200 mg
5	13 μ gm	14 μ gm	22 μ gm
10	25	32	45
15	40	45	65
20	53	66	93
25	66	82	110
Residual amount of dimethoate in the leachate	510	700	820

TABLE 4 : Leaching study of dimethoate, Ludhiana (Normal soil) pH=8.2

Time	Concentration of leachate in μ gm Amount added		
(min.)	100 mg	150 mg	200 mg
15	14 μ gm	20 μ gm	22 μ gm
30	25	30	43
45	40	46	60
60	49	63	79
75	60	84	100
90	75	95	120
105	85	110	136

TABLE 1 : Analysis of soil samples

Soil properties	Habbowal soil (Alkaline)	Palampur soil (Acidic)	PAU soil (Normal)
pH	10.0	5.7	8.2
Clay	15.9	32.0	14.5
Sand	83.0	67.7	85.1
Organic matter (%)	0.33	0.76	0.20
E. C. (m. moles)	0.20	0. 0	0.20
Texture	Sandy loam	Clay loam	Sandy loam
Field capacity	—	28.5	45.1

TABLE 5 : Movement of dimethoate in soil

Depth (cm)	Amount adsorbed		
	100 mg	150 mg	200 mg
5	10 μ gm	22 μ gm	18 μ gm
10	20	27	35
15	32	37	50
20	40	54	63
25	54	62	80
Residual amount of dimethoate in the leachate	600	660	863

TABLE 6 : Leaching of dimethoate, Habbowal soil (Alkali soil) pH = 10

Time (min.)	Concentration of leachate in μ gm Amount added		
	100 mg	150 mg	200 mg
15	9	10	13
30	15	22	27
45	26	27	40
60	32	35	50
75	39	43	62
90	45	54	71
105	54	60	89

Adsorption which depends on the attraction and repulsion of solute at the soil surface is an important factor controlling the leaching of pesticides. It is this factor which governs the biological toxicity of the pesticide[3]. Higher the clay content, lesser is the desorption of pesticide. Reduction of pH generally increases adsorption as is evident from the result in Table 2 for acidic soil. According to Nearpass[4], decreased adsorption occurred at increased pH. Titratable acidity and not soil pH was highly correlated with simazine, adsorption.

Degradation is another factor which causes some complication in assessing the mobility of triazine series. However, it was observed from TLC that it gave only one spot showing that there was no degradation in the case of dimethoate.

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Egglaying of Trinket snake of India

The Trinket snake (*Elaphe helena*) is a non-venomous snake, being a member of the family of Colubridae. A beautiful snake, it has ornate patterns running down its length. It is mostly a tree-dwelling snake feeding on mice and birds. It is an oviparous snake, the female lays 15 to 20 eggs. It inhabits nearly all over India.

The Trinket breeds at certain fixed times, i.e. during the months of January/February. The breeding season begins with courtship; mating, egg-laying, incubation and ending with hatching. The female Trinket lays her eggs during the months of April/May. The eggs are laid in clutches. The female, about to lay her eggs, is unusually restless and uneasy. She keeps moving around searching for a suitable and well-secured place to lay her eggs. Her rear portion is conspicuously thicker due to the presence of the eggs within the oviduct (Fig. 1). During the primary stage, the eggs are attached to each other in a chain form. At the time of egg-laying, each egg is disjointed and laid one by one.

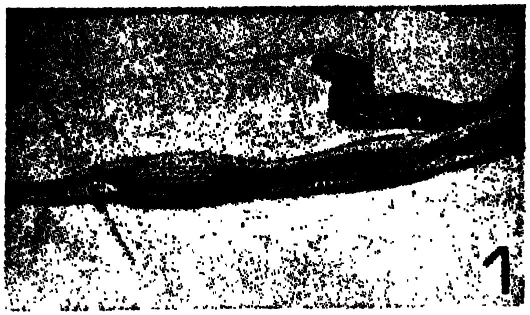

Fig. 1. The Trinket (*Elaphe helena*) is in the first stages of egg laying. The presence of the egg is predominantly seen

The swelling, due to the egg within, slowly moves towards the cloaca (posterior opening). The muscles of the body consecutively constrict and dilate, pushing the egg backwards, towards the exit. The distal portion of the tail is pressed against the ground and the proximal portion is raised, forming an arch, so as to lift the cloacal region slightly off the ground, thus releasing the compression on the egg (Figs. 2 and 3). The cloaca slowly opens, giving the viewer the first glimpse of the taper portion of the egg. This taper portion makes the circular muscles of the cloaca to stretch to their extremities, making way for the egg. The egg is slowly pushed outwards The cloacal muscles slowly start relaxing as the other taper portion of the egg passes through. This completes the egg laying (Fig. 4). Even after the egg has been laid, the cloacal opening may continue to constrict and dilate once or twice. Many a time a vascular membrane of the oviduct has been noticed to be desquamated and laid along with the egg. A thick greenish yellow liquid is often observed on the freshly laid egg. Bellairs[1] has stated that the eggs are adhered to each other by this sticky liquid, which holds them together in clutches.

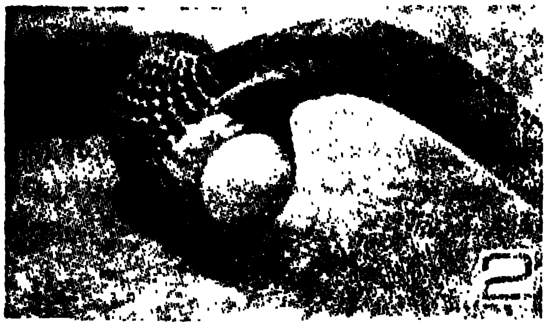

Fig. 2. A small portion of the egg is seen at the opening. The distal portion of the tail is pressed against the ground

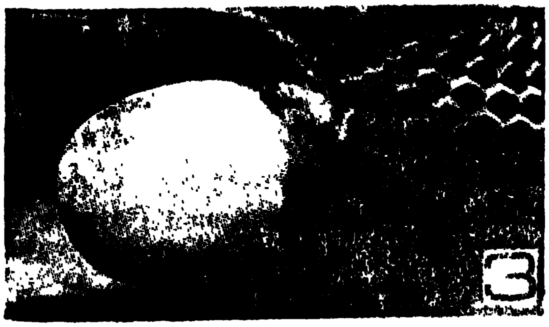

Fig. 3. The egg emerges halfway

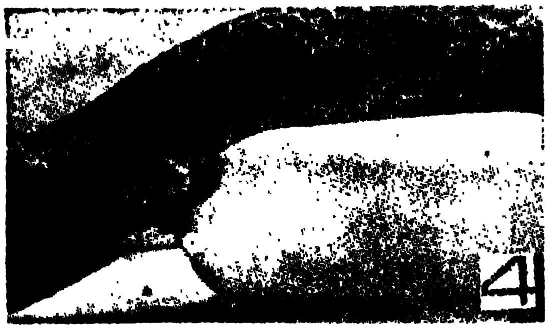

Fig. 4. A rather peculiarly sized egg, it is completely out. The cloacal muscles are relaxed

The incubation period lasts for about 60 days, depending on the environmental conditions such as temperature and humidity. Artificial incubation by raising the temperature up to certain extent has been proved to be successful to minimise the incubation period and also to decrease the mortality during this period.

During the incubation period, the embryo feeds on the yolk which is a rich nourishing mixture of fats and proteins. The yolk also contains calcium, phosphorus and other minerals which are utilised to form skeleton in the later embryonic life. The egg shell is well-developed with a fibrous structure, which is secreted by the glands present in the oviduct of the mother. The presence of a thin network of tiny blood vessels forming a sac around the embryo indicates that the egg is fertilized. As the embryonic development is carried on within the egg, the baby develops an egg tooth to cut its way out of the egg. This egg tooth is attached to the premaxillary bone which is bigger and curved forwards. Its edges are razor sharp. After the snake has cut its way out of the egg, it sheds its skin and the egg tooth within 24 hr. It also feeds within 24 hr. The young snake is a miniature replica of the parents, having inherited the necessary reflex responses needed for survival.

'Orphaned', since the parents exhibit no maternal care, it lies vulnerable, exposed to the forces of nature. Having sheltered and nurtured so many 'orphans', one is bewitched and compelled to investigate and probe into the veiled reptilian mysteries.

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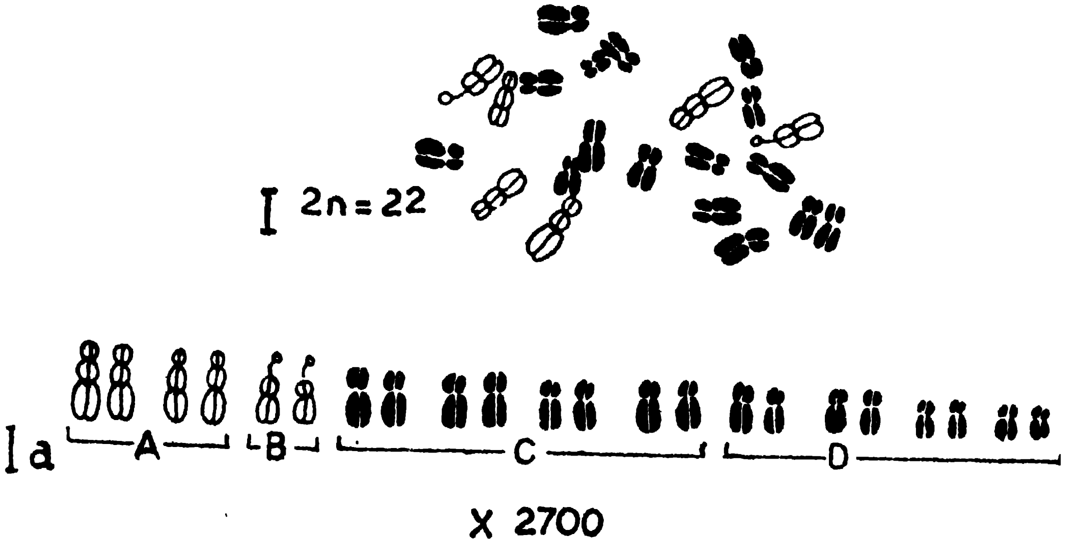
Chromosome studies in *Peperomia polybotrya* H.B.K.—A new record

Peperomia polybotrya H.B.K. is an ornamental succulent plant with an upright bushy habit belonging to the family Piperaceae which includes 9 genera and about 1300 species of which more than 600 species belongs to the genus *Peperomia*[1]. Many species of *Peperomia* are cultivated for their showy leaves and a number of species have been used for many years as ornamental plants and at present new varieties are being added in horticultural trade. Despite the very great importance in horticultural trade of this group, it is remarkable that very little attention has been so far paid to the chromosome constitution. The neglect of this genus cytologically may be due to the difficulties in identifying the species, because of the small flowering parts and the uniform morphology found both in the vegetative and floral parts of the genus *Peperomia*.

The detailed cytological studies were carried out with the aid of improved techniques[2] with a view to understand the chromosome complement, from temporary squash preparations of root tips of *P. polybotrya* H.B.K., which was procured from Bangalore and planted in the experimental Botanical garden of Calcutta University The root tips were pretreated in a mixture of saturated solution of paradichlorobenzene and 0.002 M 8-hydroxyquinoline solution (1 : 1) at 0°-5°C for 3-5 minutes and then at 14°-15°C for 3 hours. They were fixed in acetic acid-ethyl alcohol mixture (1 : 2) for 1-2 hours. The usual schedule for acetic-orcein staining was followed.

The detailed karyotype complement shows the somatic chromosome number is 2n=22 (Fig. 1). There were clearly 3 pairs with secondary constrictions, of which one pair with satellite. The range of chromosome length varies from 3.52 μ to 1.30 μ. The Table 1 shows the detailed karyotype.



Figs. 1 and 1a. Somatic metaphase with 2n=22 chromosomes and idiogram respectively. × 2700 (approx.)

TABLE 1 : Detailed karyotype analysis of *P. polybotrya* H.B.K. at metaphase (Fig. Ia)

Chr. type	Chr. No. pairs	Total length in μ	Short arm length in μ	Centromeric index (i) F%	Nature of primary constriction	Secondary constriction
A	1	3.52	0.93	26.32		
			1.48	42.11	Nearly median	Present
	1	2.96	0.74	25.00		
			1.30	43.75	Nearly median	Present
B	1	3.33	0.46	13.89		
			1.30	38.89	Nearly madian	Satellite
C	2	2.59	1.11	42.86	Nearly median	Absent
	2	2.22	0.93	41.67	Nearly median	Absent
D	2	2.04	0.74	36.36	Nearly submedian	Absent
	1	1.67	0.65	38.89	Nearly median	Absent
	1	1.30	0.56	42.86	Nearly median	Absent

As far as the chromosome number reports are concerned; the genus *Peperomia* is highly controversial, may be due to the extensive vegetative means of propagation. In view of the fact that a large number of species constitute the genus *Peperomia*, the cytological data seems to be very meagre. The base number $X=11$ tallied with observations on other numbers of the genus *Peperomia* were $X=11$ and 12 chromosomes, has been recorded earlier[3-7].

The author expresses his deep indebtedness to Prof. A. K. Sharma, Project Coordinator, Centre of Advanced Study on Cell and Chromosome Research, Department of Botany, University of Calcutta, for guidance and encouragement and to Prof. (Mrs.) A. Sharma, for helpful suggestions and also grateful to Dr. (Mrs.) Mandira Sarma for the kind help.

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Storage life of okra

In a previous communication[1], we peported that polythene cover is quite useful in the enchancement of the storage life of certain vegetables. This package system worked most efficiently in the case of leafy vegetables. The present study deals with the storage life of okra [*Abelmoschus esculentus* (L.) *Moench* cv. Pusa Sawani]. Various storage conditions used were polythene cover (perforated and unperforated), spray with 0.5% KH_2PO_4 and open condition (Fruits on tray). Relative humidity (44-100%) and temperature (min. 16-20°C & max. 21-30°C) were recorded throughout the experiment. The changes in ascorbic acid, total soluble solids (T.S.S.) and free-amino acids were also recorded by methods reported earlier[2,3].

It was observed that the shelf life (open condition on tray) was enhanced from 2 days to 15 days, using unperforated polythene cover (Table 1). Perforated polythene cover

TABLE 1 : Studies on storage life of okra

Storage Treatment	Storage life (days)	Biochemical constituents			
		Pre-storage		Post-storage	
		T. S. S. %	Ascorbic acid (mg/100g)	T. S. S. %	Ascorbic acid (mg/100g)
Open condition	02	2.00	22.91	>32.00*	8.80
Polythene cover	15	2.00	22.91	>32.00	12.43
Polythene cover (perforated)	07	2.00	22.91	>32.00	11.32
0.5% KH_2OP_4	05	2.00	22.91	>32.00	10.54

* T. S. S. was recorded on Erma hand refractrometer model 8918 range (0-32%). >32% indicates the value of T. S. S. beyond the range of the refractrometer, the vegetable has become semidry or dry.

was also found helpful in extending storage life by about a week. The spray of 0.5% KH_2PO_4 solution at the time of storage increased shelf life of the vegetable.

As regards the changes in biochemical constituents during storage, it was noticed that there was a regular fall in the content of ascorbic acid on keeping (open condition on tray) and the loss was somewhat less in polythene. The freshness of the vegetable was directly related to the value of T.S.S. It can be conveniently declared as 'Not acceptable' when the value of T.S.S. goes beyond 32%. Beyond this value, the vegetable loses most of its water content and becomes dry or semidry[3]. Five amino acids (free form) namely, Ornithine, glycine, methionine, Isoleucine and Leucine were tentatively identified. On storage little or no change in amino acids (qualitatively) was observed. The results clearly indicate that storage life of okra could be appreciably extended by the use of polythene cover.

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A histochemical technique for detection of cellulose in *Ascidiella aspersa*

Controversy exists as regards the occurrence of cellulose in the test (tunic) of Ascidians. Histochemical investigations have failed to detect cellulose in the test of *Pyura stolonifera* and *Halocynthia aurantium*[1-3]. But later studies[3-5] have shown its existence in the test in the form of complexes with proteins and polysaccharides. It was further revealed that the reaction of the test (tunic) with phosphoric acid can result in the break up of the hydrogen bonds between adjacent sugar polymers of cellulose strands[5]. That the acid mucopolysaccharides contained in the test of *Polyclinum madrasensis* was removed by phosphoric acid treatment was also reported[6]. In the light of this, an attempt was made to identify cellulose histochemically in the test of *Ascidiella aspersa* using iodine-sulphuric acid test, following a pre-treatment of the tissue with phosphoric acid.

The following procedure was carried out using fresh Cryocut sections of the test of *A. aspersa* : (a) Treat sections with phosphoric acid for 5 mins ; (b) Remove sections and wash with distilled water ; (c) Introduce 2 or 3 drops of 0.1% iodine solution ; (d) Add a few drops of dilute sulphuric acid (2 acid : 1 water) and observe the colour developed. A control test was also carried out omitting the phosphoric acid treatment.

A dark blue colour appears in sections treated with phosphoric acid in a few minutes which is indicative of the presence of cellulose, whereas control test showed no such colour development. From the positive response to iodine sulphuric acid test after treatment with phosphoric acid, it is inferred that cellulose exists in the test of *A. aspersa* and that its sites become exposed for reaction only on treatment with phosphoric acid.

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Decolourised basic dyes—their use in the detection of some organic compounds

In an earlier investigation, it was found that an aqueous solution of basic fuchsin, decolourised with N H_2SO_4 and sodium sulphide ($Na_2S.2H_2O$), can be used to detect several different organic compounds, such as alcohols, aldehydes, ketones carboxylic acids, an amide and amines (Dutt, unpublished). Since dyes other than basic fuchsin stain DNA-aldehyde molecules of acid hydrolysed tissue sections in Feulgen procedure[1], it was thought that perhaps such dyes decolourised with sulphuric acid and sodium sulphide would also be suitable for the detection of different organic compounds. This assumption was found true of at least three dyes, such as toluidine blue O, brilliant cresyl blue and Meldola's blue[2]. The present report furnishes findings as to the suitability of three other basic dyes for the *in vitro* detection of some organic compounds.

The dyes used in this investigation were azure A (Chroma, C. I. No. 52005) with primary amino group in its molecule, methylene green (G. T. Gurr, C. I. No. 52020) and crystal violet (Merck, C. I. No. 42555), both without primary amino group in their molecules. The first two dyes belong to thiazine, while the third one to aminotriarylmethane group. The dye-reagents were prepared as follow : To 100 ml of 0.2% aqueous solution of each of the dyes, dissolved in warm distilled water, were added 5 ml of N H_2SO_4 and 1.0 g of sodium sulphide and shaken very thoroughly for a minute. The first two dyes became reduced to a pale straw colour while the last-mentioned one to a completely colourless state. These were then filtered. The pHs of the filtrates of azure A, methylene green and crystal violet dye-reagents were 10.1, 9.8 and 10.0 respectively.

The different organic compounds tested to show positive or negative results are presented in Table 1. The colours of the dye-reagent-compound mixtures are also shown there. It is evident that azure A dye-reagent is most suitable for *in vitro* detection of all the organic compounds excepting pyridine. Methylene green and crystal violet dye-reagents are also suitable for the detection of most of the compounds but not all. Pyridine gives negative reaction with methylene green and crystal violet reagents also. The four ketones tested show positive reaction with azure A and methylene green dye-reagents. Two of these show positive reaction with crystal violet dye-reagent, whereas the other two show negative response. All the liquid aldehydes give positive results with azure A and methylene green dye-reagents but not

TABLE 1 : Reaction of three basic dyes with some organic compounds

Compounds	Azure A	Methylene green	Crystal violet
I. *Alcohols*			
(a) Methanol	+ve (violet ring)	+ve (ext. pale pink)	+ve (upper blue ; lower colourless)
(b) Ethanol	+ve (violet upper layer)	+ve (pale dirty pink)	+ve (pale violet)
(c) n-Propanol	+ve (violet ring)	+ve (pale yellow)	+ve (ext pale violet)
(d) iso-Propanol	+ve (deep red)	+ve (dull pink)	—ve
(e) n-Butanol	+ve (violet ring)	+ve (upper deep violet)	+ve (lower blue)
(f) iso-Butanol	+ve („)	+ve („)	+ve (upper violet)
(g) tert-Butanol	+ve („)	+ve (pale violet)	+ve (ext. pale violet)
(h) n-Pentanol	+ve (upper deep blue)	+ve (upper ext. pale violet)	+ve („)
II. *Phenols*			
(a) Resorcinol	Not possible	Not possible	—ve (after 20 min.)
(b) Quinol	Not possible	Not possible	+ve (lower ext. pale yellow)
III. *Aldehydes*			
(a) Formaldehyde	+ve (violet)	—ve	+ve (pale violet)
(b) Acetaldehyde	+ve (milky, sky-blue)	—ve	+ve (ext. pale blue)
(c) Glutaraldehyde	+ve (green)	+ve (pale green)	+ve (pale blue)
(d) Paraldehyde	+ve (violet)	+ve (upper sky-blue lower deep blue)	+ve (upper pale violet)
(e) Benzaldehyde	+ve (straw with green ppt.)	+ve (upper milky ; green ppt.)	+ve (blue with blue ppt.)
(f) Salicylaldehyde	+ve (golden yellow with yellow ppt.)	+ve (pale yellow)	+ve (deep yellow with blue ppt.)
(g) p-Hydroxy benzaldehyde	Not possible	Not possible	+ve (pale yellow after 30 min.)
(h) Vanillin	Not possible	Not possible	—ve
(i) Veratraldehyde	Not possible	Not possible	—ve
(j) p-Nitrobenzaldehyde	Not possible	Not possible	+ve (5 min-lower deep yellow)
(k) p-Dimethylamino-benzaldehyde	Not possible	Not possible	—ve (after 10 min.)
(l) Cinnamaldehyde	+ve (moss green)	+ve (moss green)	+ve (upper ext. pale blue ; lower yellowish-green)
IV. *Ketones*			
(a) Acetone	+ve (upper red layer)	+ve (ext. pale violet)	—ve
(b) Methyl ethyl ketone	+ve (upper violet)	+ve („)	—ve
(c) Cyclohexanone	+ve (upper navy blue)	+ve (upper light brown ; lower milky colourless)	+ve (upper sky-blue ; lower turbid colourless)
(d) Acetophenone	+ve (upper straw ; lower violet ppt.)	+ve (upper straw ; lower sky-blue)	+ve (upper turbid colourless ; lower sky-blue)
(e) Benzophenone	Not possible	Not possible	—ve (after 20 min.)
V. *Carboxylic acids*			
(a) Formic acid	+ve (turbid sky-blue)	+ve (turbid colourless)	+ve (turbid, ext. pale blue)
(b) Acetic acid	+ve (blue)	+ve („)	+ve („)
(c) Linoleic acid	+ve (upper green)	+ve (upper deep green)	+ve (upper pale blue ; lower pale violet)
(d) Oleic acid	+ve („)	+ve („)	+ve (upper dirty violet)
(e) Phenylacetic acid	Not possible	Not possible	+ve (ext. pale violet)
(f) Phthalic acid	Not possible	Not possible	+ve (sky-blue)

TABLE 1 (Contd.)

Compounds	Azure A	Methylene green	Crystal violet
VI. *Amines*			
(a) Ethyl amine	+ve (pale violet)	+ve (ext. pale violet) soon disappears	—ve
(b) Tributylamine	+ve (red)	—ve	—ve
(c) Dimethylaniline	+ve (red)	—ve	+ve (upper pale pink
(d) Pyridine	—ve	—ve	—ve
VII. *Ethers*			
(a) Solvent ether	+ve (upper red ; lower colourless)	+ve (upper pale violet ; lower straw)	—ve
(b) Anisole	+ve („)	+ve („)	—ve
(c) Phenetole	+ve („)	+ve (upper deep violet ; lower straw)	—ve
(d) Tetrahydrofuran	+ve (reddish-violet)	+ve (greenish-violet ; soon disappears)	+ve (ext. pale yellow)
(e) Dioxane	+ve (ext. pale blue)	+ve (sky-blue ; soon disappears)	+ve (pale blue)

with crystal violet reagent. Carboxylic acids excepting the two solid ones give positive reaction with all the three reagents. Since both solvent ether and chloroform react with both azure A and methylene green reagents but not with crystal violet reagent, solid organic compounds dissolved in solvent ether could not be tested with the former two reagents. Both azure A and methylene green dye-reagents react with tap or distilled water producing violet colouration while crystal violet reagent show no reaction. With the addition of conc. NaOH, all the three dye-reagents react by producing colours without effervescence. Addition of conc. HCl to azure A and methylene green dye-reagents produces cloudy appearence while addition of this acid to crystal violet reagent shows lack of response. From all these observations, it is logical to conclude that colour formation of organic compounds with these dye-reagents is primarily due to chemical reaction and a change in the hydrogen ion concentration can only be an additional factor.

It is necessary to point out here that none of the three dye-reagents can be confused with Schiff's reagent, because the latter reagent turns out to be purple on being heated or when irradiated with short wave UV rays[3], whereas the present dye-reagents do not exhibit any such phenomena. Dye-reagent prepared with basic fuchsin also exhibit these phenomena. Under the circumstances, the present author feels that all these dye-reagents can be considered as entirely new and that these can be used as routine laboratory reagents for *in vitro* detection of several organic compounds.

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On Anti-H Reactivity of the Saliva and Red Blood Cells

It is well-known that persons with O blood group are detected as secretors and non-secretors according to whether their saliva contains H. Secretors of A, B and AB groups also have H in their saliva[1]. It

seems that by using Anti-H reagent (*Ulex europeus* extract) secretor and non-secretor status of the persons with regard to H substance from their saliva can be detected by utilizing the inhibition test.

There are two distinct forms of group-specific substance, one water-soluble glycoprotein which is present in most body fluids and the other alcohol-soluble glycolipid present in red cells and almost all other tissues, but absent from the secretions[1]. It is, however, yet to be thoroughly known whether the alcohol-soluble glycolipid type of group specific substance reacts in similar way with the Anti-H as it reacts in the case of water-soluble glycoprotein type of group specific substance. With the above-mentioned idea in view, an attempt has been made to examine the relationship between the reactivity of the Anti-H reagent to salivary secretion and red blood cells.

The material for the present study was collected from 102 (male—43, female—59) individuals of Bengalee Hindu population of different caste groups. Saliva and blood from the persons were collected in the Genetics Laboratory, Ramakrishna Mission Seva Pratisthan, Calcutta. The collection of blood was done[2], while ABO groupings were done[1], in the same Genetics Laboratory. The collection and preparation of saliva for inhibition test using Anti-H reagent was done[1]. Secretor status from saliva was determined following standard slide method and H status from blood was done directly from red-blood cells using Anti-H reagent.

Statistical test does not reveal heterogeneity in distribution of ABO blood groups in the two sexes and hence the samples of both the sexes have been combined for further analysis.

The data was arranged and calculated to examine differential distribution of H-group specific substance in the different blood groups in Table 1. The differential distribution was seen to be statistically significant in case of RBC (X_2=17.32^2 $P<0.05$), while it was not so in case of saliva (X^2=3.55, $P>0.05$).

The estimation of the gene frequency for the secretor and non-secretor factors was determined by using the square root formula. Frequency of the secretor gene (Se) is slightly higher among male (0.7844) than female (0.6556) in case of RBC, while the reverse result is seen in case of saliva (male=0.4717 and female=0.5488).

The present investigation indicates the existence of different genetic mechanism for the water-soluble and alcohol-soluble group

TABLE 1 : Anti-H reactivity of the RBC and Saliva according to ABO blood groups

Blood Group		Anti-H positive		Anti-H negative		Total	
		RBC	Saliva	RBC	Saliva	RBC	Saliva
O	N	25	22	—	3	25	25
	%	100.00	88.00	—	12.00	100.00	100.00
A	N	28	22	5	11	33	33
	%	84.85	66.67	15.15	33.33	100.00	100.00
B	N	37	29	1	9	38	38
	%	97.37	76.32	2.63	23.68	100.00	100.00
AB	N	3	5	3	1	6	6
	%	50.00	83.33	50.00	16.67	100.00	100.00
Total	N	93	78	9	24	102	102
	%	91.18	76.47	8.82	23.53	100.00	100.00

X^2 = 17.32 (3 d. f.); $P<0.05$ (in case of RBC)
X^2 = 3.55 (3 d. f.); $P>0.05$ (in case of saliva).

specific substances. Further work with additional data and methodology, however, are necessary to know the fact more clearly.

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Study of relative consequences of water and salt stresses in pearlmillet

Salt stress, unlike water stress, enforces not only osmotic, but also ionic effects on plants. It has been suggested[1] that in agronomic species salt tolerance is usually associated with ion-exclusion from the tissue, implying that salt-tolerant varieties may be susceptible to water deficits. Ion effects dominate, in contrast, in salt-sensitive varieties. Although supporting evidence, in this respect, are available for a number of crops[2-5] of agricultural importance, hardly any information on the cultivars of pearlmillet, a crop adapted to dry regions, exists to show its relative tolerance to salt and water stresses.

In order to gain information on this subject, pearlmillet (*Pennisetum typhoides*) cultivars, BJ 104 (a hybrid) and Babapuri (communicated to be salt-tolerant by Dr. M. B. L. Saxena of the Coordinated Millet Improvement Scheme) were grown in plastic-lined pots under sand (8 kg acid-washed river sand) culture condition with Hoagland nutrient solution and 20 day-old plants were irrigated once (1 lit/pot) either with polyethylene glycol (PEG)-6000 or NaCl, each at −10 bars (1.01 MPa) iso-osmotic concentration. The control plants were irrigated with tap water. A randomised block design was adopted where 10 pots, each with three plants, served as replicates in each of the six treatments. Leaf-RNA was estimated according to the method of Nieman and Poulsen[6], while the remaining enzymes and metabolites were analysed adopting methods reported earlier[7,8].

The analysis of varience of the data on plant performance indicated significant effects due to stress treatments but not due to variety or their interaction. Therefore, marginal means of stress treatments have only been presented in Table 1 which indicates that both PEG and NaCl had adverse influences on the performance. But the detrimental effects caused by NaCl were significantly more, as compared to PEG, in case of growth in height and 1000-grain weight while these were not large enough to be significant for the shoot dry weight and grain weight per plant.

TABLE 1 : Influences of iso-osmotic PEG and NaCl on plant performance

Treatment	Plant height (cm)	Shoot dry wt. (g plant^{-1})	Grain wt. (g plant^{-1})	1000 grain wt. (g plant^{-1})
Control	92.1	9.2	4.04	6.59
PEG	89.6	7.1	2.76	5.83
NaCl	76.4	5.7	2.50	5.29
L. S. D.				
5%	9.8	1.9	1.04	0.19
1%	13.1	2.6	1.42	0.26

Study of certain leaf enzymes and metabolites; at 30, 45 and 60 days from sowing also suggested that NaCl brought about larger metabolic derangements in both the cultivars as compared to PEG. The data obtained on the 45th day of sowing have only been reflected in Table 2 for the purpose of brevity and to show the trend of results. It may be found that the decline in chlorophyll content, under water and salt stresses were small and comparable, but in both the cultivars, NaCl-mediated reduction in the level of soluble protein and increase in RNA level was more as compared to those induced by PEG. This trend of increase of RNA under salt stress was comparable to that observed in *Phaseolus valgaris*[9] and could be due to an increase in activity of DNA-dependent RNA polymerase enzyme. Salt-induced decline in the pyrophosphatase activity was more in both the cultivars, but for nitrate reductase this was true only in case of cv. Babapuri, Similarly; increase in peroxidase activity due to NaCl was more in this cultivar; as compared to PEG but in cv. BJ 104 both the stresses had comparable increases in activity.

TABLE 2 : Influences of iso-osmotic NaCl and PEG on certain leaf enzymes and metabolites of cv. BJ 104 and Babapuri on 45th day of sowing

Observation	BJ 104			Babapuri		
	Control	PEG	NaCl	Control	PEG	NaCl
Chlorophyll (mg g^{-1} d. wt.)	3.56	3.22	3.26	3.68	2.48	2.46
Soluble protein (mg g^{-1} d. wt.)	164.3	102.3	86.4	138.0	130.9	90.5
RNA (mg g^{-1} d. wt.)	11.75	16.15	19.25	18.30	21.10	23.70
Nitrate reductase (ug NO_2 g^{-1} d. wt. h^{-1})	103.6	61.1	91.6	84.6	70.7	63.6
Peroxidase (mg g^{-1} d. wt.)	0.48	1.07	0.92	0.34	0.55	1.02
Alkaline pyrophosphatase (mg Pi g^{-1} d. wt. h^{-1})	39.1	32.9	26.6	29.4	28.8	18.6

Taking all the facts into consideration the cultivar differences do not acquire any significance, while it seems that this crop generally suffers more from salt (NaCl) rather than water stress, under a comparable osmotic condition.

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Rhizosphere microflora of commonly growing weeds in industrial areas of Burdwan, West Bengal

Ecophysiological studies on weeds have been done largely on species inhabiting western, northern and central parts of India. However, there is little mention of plants from the eastern counterpart to which West Bengal belongs. As the soil and climatic conditions vary in different parts of the State, they provide interesting material and ample scope for valuable investigations on ecophysiological aspects of herbaceous weeds. The coal-steel-fertiliser complex of Burdwan, embracing Asansol, Durgapur, Jambad and Raniganj, harbours a distinct type of rainy-season therophytes—*Cassia sophera* L., *C. tora* L., *Desmodium triflorum* DC., *Evolvulus nummularius* (L.) L., *Malachra capitata* L., *Sida acuta* Burm., *Trianthema portulacastrum* L. and *Tribulus terrestris* L.—not evident elsewhere in West Bengal or in other States. Although responsible leaders in weedology have called for ecological approaches to weed work$^{1-3}$, the microflora associated with the rhizosphere of Indian weeds has not been probed. Hence, the present account is an attempt to unravel the mystery of the fungal and bacterial organisms encountered in the underground portion of such weeds.

Fungal and bacterial composition of the rhizosphere of the eight weeds were studied by germinating 20 seeds of each species wrapped in double layers of fine muslin cloth and placed 6 cm below the soil surface for 7 days. The soil from different zones of rhizosphere of each species was administered in 1 and 10 ppm dilutions in sterile Petri-dishes (10 cm diam), containing Czapek's Dox media for fungal and nutrient agar and gelatine media for bacterial studies. The fungi were identified and the structure of the bacteria noted after gram-staining.

TABLE 1 : Bacterial composition of rhizosphere of weeds under study

Species	Dilution (ppm)	Structure of microbial associates	Regions
Cassia sophera	10A	Cocci with pointed ends	I, II, IV
	10G	Some bacilli, size 0.04 μ	I, IV
	1A	Very small cocci clumped together	II, III
Cassia tora	10A	All cocci, some diplococci also	II, III
	10G	All bacilli	I, II, IV
	1A	Very small cocci & bacilli mixed	I, IV
Desmodium triflorum	10A	Big cocci	I, II, III
	10G	Small cocci, a few bacilli	I, II, IV
	1A	Big bacilli	II, III, IV
Evolvulus nummularius	10A	Cocci, tendency of coma	III, IV
	10G	Bacilli & cocci mixed	I, II, III
	1A	Cross rods & cocci together*	I, II, IV
Malachra capitata	10A	Cocci clumped together*	I, IV
	10G	Cocci scattered*	II
	1A	Both cocci & bacilli	II, III, IV
Sida acuta	10A	Cocci with a few bacilli*	I, II, III, IV
	10G	Big double cocci*	II, IV
	1A	Cocci & bacilli mixed	I, III
Trianthema portulacastrum	10A	Distinct bacilli, scattered, big	I, II, III
	1A	Bacilli clumped, small*	I, III, IV
Tribulus terrestris	10A	Small cocci, a few bacilli	II, IV
	10G	Small bacilli	I, III, IV
	1A	Big bacilli & small cocci*	II, III

A = Grown in agar medium ; I = Raniganj ; II = Asansol ; *Gram-negative,
G = Grown in gelatine medium III = Jambad ; IV = Durgapur but rest gram-positive

Library.

The rhizosphere of the various weeds abounds in microflora. The bacterial population commonly occurs in Raniganj, Asansol and Durgapur (Table 1). But the fungal population prevails less in Asansol and Durgapur and more in Jambad (Table 2). The mostpolluted Durgapur area contains less fungi and more bacteria ; this may be ascribed to nitrogenous wastes arising from the local industries flourishing there. The rhizosphere of leguminous weeds are invariably associated with gram-positive bacteria, but non-leguminous weeds are accompanied by both gram-positive and gram-negative bacteria. In this connection, it may be worth mentioning that cocci are the dominating bacteria in Asansol and bacilli in Raniganj ; the former region is a component of the industrial sector and the latter of the colliery.

TABLE 2 : Fungal composition of the rhizosphere of weeds under study

Species	Fungal associates	Regions
Cassia sophera	*Corynespora cassicola*	II, III & IV
	Periconia byssoides	I & III
Cassia tora	*Aecidium cassiae*	I, III & IV
	Cercospora sp.	III & IV
	Choanephora incarbitarum	I & III
	Oidium sp.	II & IV
	Sarcinella cassiae	I, II & III
Desmodium triflorum	*Parodiella perisporoides*	I & III
Evolvulus nummularius	*Albugo evolvuli*	I, II & IV
Malachra capitata	Nil	
Sida acuta	*Coleosporium sidae*	II & III
Trianthema portulacastrum	Nil	
Tribulus terrestris	Nil	

I=Raniganj ; II=Asansol
III=Jambad ; IV=Durgapur

Whereas the identity of the bacterial flora was not established, this has been possible for the fungal flora. In its rhizosphere, *Cassia tora* harbours the maximum number of fungi. This is followed by *C. sophera* which is afflicted with two different fungi. *Desmodium triflorum*, *Evolvulus nummularius* and *Sida aouta* are each affected by a single fungus. Interestingly, the rhizosphere of no two seeds are susceptible to the same fungal organism. But *Malachra capitata*, *Trianthema portulacastrum* and *Tribulus terrestris* do not seem to tolerate any fungi in their rhizosphere in contrast to the bacterial flora dwelling there.

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Allelopathic effects of *Chenopodium murale* —an aspect of weed control for non-associated species

Chenopodium murale L., a noxious weed, is a source of irritation to the cultivators in the plains of West Bengal during the post-monsoon season[1]. It also contains toxic substances, some of which can persist in soils long enough to carry an allelopathic influence[2]. In terms of allelopathy, Rice[3] stated that many weeds produce toxins that are inhibitory not only to crop plants but also to other weeds and often to themselves. When winter crops[4] like mustard and wheat were treated to foliar spray and soil-dressing of the extract of three weeds—*Amaranthus spinosus* L., *Chrysopogon aciculatus* (Retz.) Trin. and *Eupatorium odoratum* L.—both vegetative and reproductive phases of receptor plants were seriously affected; here sprayed extracts were more effective than the soil-applied extracts. Datta and Ghosh[5] investigated the effect of pre-sowing treatment of leaf- and inflorescence-extracts on mustard, observing greater phyto-toxicity with 1 : 2.5 concentration of the leaf-extract. Such being the situation, it was thought desirable to find out whether inhibitors generated by one weed (*Chenopodium murale*) could be tried in the form of a foliar spray against other weeds—*Abutilon indicum* (L.) Sw., *Cassia sophera* L. var. *purpurea* Bak., *C. tora* L., *Crotalaria pallida* var. *pallida* Ait and *Tephrosia hamiltonii* J. R. Drumm.—with which the donor species is not associated under natural conditions and hence could serve as a model for weed control.

Seeds of target weeds were scarified in conc. H_2SO_4 for 20 min (except *Abutilon indicum* which was of 2-hr duration), washed thoroughly with distilled water and sown in 30-cm pots containing loamy soil fertilised with cowdung manure. When sufficient number of seedlings emerged, they were thinned down to 10 per pot. Aerial spray of *Chenopodium* extracts were started 45 days after sowing and followed on alternate days (with a total of 10 applications per treatment). There were four pots per treatment. Adequate controls, which received no *Chenopodium* extracts, were maintained throughout the experimental period. Before application, 40 gm of fresh *Chenopodium* leaves were crushed in a Bajaj mixture with glass-distilled water and the extract filtered; the filtrate was brought to 100 ml with the addition of water and constituted the stock inhibitor solution (1 : 2.5) from which other concentrations were obtained by way of dilution. The above ground portion of test weeds was subjected to aerial spray by means of mouth sprayer, with 25 ml of the leaf-extract per application. All plants were watered as and when necessary and allowed to grow into maturity. Then were harvested and various growth parameters recorded.

Chlorosis was evident in all weeds after spraying with 1 : 2.5 concentration of *Chenopodium* leaf-extract, being more in *Cassia tora* and *Tephrosia hamiltonii* than in other receptor species. With such a spray, there was complete defoliation in *C. tora* and not in other weeds. Plant height was inhibited in *C. tora* and *T. hamiltonii* by the maximum concentration of the extract, but was stimulated in *Abutilon indicum* and *C. sophera* var. *purpurea* by higher concentrations (1 : 2.5 & 1 : 5) and *C. tora* and *Crotalaria pallida* var. *pallida* by 1 : 10 concentration (Table 1). Branches failed to form in *Abutilon* plants at all concentration and *Cassia* plants at 1 : 2.5 extract. In other weeds, there was a progressive decline in branching with increasing amount of the extract. While fruit output was reduced in *Cassia* plants at all concentrations, it was generally at 1 : 2.5 concentration which also caused a lowering of the fruit length in all weeds. A significant fall in seed output of various weeds was registered at higher concentrations of the extract, but 100-seed weight decreased only at 1 : 2.5 concentration for all weeds except *Abutilon*. Dry weight in *C. tora*, *Crotalaria pallida* var. *pallida* and *Tephrosia hamiltonii* plants was reduced by higher concentrations of the extract, whereas there was a reduction for *Cassia sophera* var. *purpurea* with 1 : 2.5 extract and no reduction at all for *Abutilon* plants with any concentration.

Though plant height seemed to be least retarded by the foliar spray of *Chenopodium*, branching and fruit output happened to be uniformly curtailed in all weeds. As regards other traits, the non-legume *Abutilon*

TABLE 1 : Performance of weeds sprayed by *Chenopodium murale* leaf-extract of different concentrations (results expressed as percentage of corresponding controls)

Traits	*Abutilon indicum*			*Cassia sophera* var. *purpurea*			*Cassia tora*			*Crotalaria pallida* var. *pallida*			*Tephrosia hamiltonii*		
	1 : 2.5	1 : 5	1 : 10	1 : 2.5	1 : 5	1 : 10	1 : 2.5	1 : 5	1 : 10	1 : 2.5	1 : 5	1 : 10	1 : 2.5	1 : 5	1 : 10
Plant height	94.14	119.50	128.38	134.38	163.74	201.19	73.34	100.25	137.14	95.84	100.74	115.24	81.24	98.68	104.62
Branches/plant	0	0	0	0	2.85	12.86	0	9.99	29.97	6.00	13.00	52.00	3.55	4.84	8.39
Fruits/plant	44.48	55.60	111.20	20.50	66.68	66.68	0	56.61	86.58	40.52	100.00	125.00	89.91	117.45	200.07
Fruit length	87.36	97.34	87.98	61.16	83.47	118.10	0	176.87	195.61	85.42	94.24	105.79	50.66	93.32	122.65
Seeds/fruit	55.50	73.26	106.56	28.95	39.96	86.58	0	70.56	111.72	0	87.64	134.59	40.00	80.00	100.00
100-seed weight	96.74	97.68	102.33	80.00	88.13	93.22	0	100.00	100.00	0	80.00	98.00	88.06	92.54	107.46
Dry wt./plant	95.58	103.68	105.62	68.80	97.60	166.40	15.48	26.08	128.77	79.50	84.80	116.60	59.16	79.56	100.74

indicum could withstand the phytotoxic action of *Chenopodium* better than the legumes. Among the leguminous weeds, *Cassia tora* was maximally inhibited in every aspect of phenology and this was followed by *Crotalaria pallida* var. *pallida*. Thus, 1 : 2.5 leaf-extracts of *Chenopodium murale* acted as a deterrent to certain phases of plant growth of these two weeds involving the production of dry weight, branches as well as fruits/seeds and could be applied to suppress such weeds in the natural habitat.

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Analysis of yield loss due to bacterial blight of rice

Bacterial blight of rice caused by *Xanthomonas campestris* pv. *oryzae* (Ishiyama) Dye, occurs almost in all rice-growing areas of the country. The grain loss is highly variable depending on the level of severity, Precise estimate of yield loss due to bacterial blight is not available in India[1]. Previous reports are also inconsistent[1-3]. For example, 22.7% damage is known to occur in Maharashtra[2], while in Andhra Pradesh it varies from 6-60%[1,3]. Therefore, it is important to identify the major component(s) that are primarily affected due to the disease and consequently contributing largely to the yield loss. This will help to develop an appropriate method for breeding rice for bacterial blight resistance. Accordingly, pathogenicity tests of a virulent isolate of *X. campestris* pv. *oryzae* was carried out on two susceptible (cvs. IR-8 & Jaya) and two resistant, (cvs. BJ 1 & IET 4141) rice cultivars; at maximum tillering, booting and flowering stages, following the standard clip-inoculation technique[4]. For this, the rices were grown in kharif seasons of 1981 and 1982 at University experimental farms. Nitrogen level of 40 kg/ha in the form of urea was applied in two doses, viz. after transplantation and before flowering. Soil pH during the growing season ranged between 7.6 to 8.0. Determinations of specific density and seed volume were done by displacement method[5], using light paraffin oil and 100-200 seeds per sample.

All the yield components were affected adversely to varying degrees at different growth stages of infected plants (Table 1). But maximum effect was observed on grain filling. Significant reduction in grain filling led to high degree of seed sterility (i.e. production of 'chaffy grains'). The total grain number per panicle, however, was not affected significantly, especially, when infection occurred at later growth stages. Highest loss in yield and its components was observed at maximum tillering (54-57%), followed by booting (30-48%) and flowering (29-38%) stages. The basic pattern of quantitative reduction in yield and yield components was found to be similar for both, resistant and susceptible cultivars. But the yield loss due to reduction in productive tiller number was extremely high for susceptible cultivars. The loss in specific density of grains indicated significant reduction in percentage of grain filling except for the resistant cultivars which were infected at the flowering stage (Table 1). The decrease in specific density was due to reduction both in grain weight and grain volume, the reduction in grain weight being high.

Bacterial blight is a vascular wilt disease

TABLE 1 : Effect of bacterial blight incidence on yield and yield components of four rice cultivars at different growth stages

(Mean value of 40 observations)

Component	Cultivar	Healthy (control)	Disease affected stage		
			Maximum tillering	Booting	Flowering
Grain yield per plant (g)	IR8	23.7±0.82	10.9±1.18	16.6±1.05	16.8±0.87
	Jaya	35.2±1.06	15.2±1.85	18.1±0.96	21.8±0.97
	BJI	33.0±1.14	30.5±1.72	31.3^{a} ±1.10	31.9^{a} ±1.04
	IET.4141	3[illegible].9±0.98	30.5±1.10	32.6^{b} ±1 08	32.7^{b} ±0.96
Number of productive tillers per plant	IR8	9.5±0.21	5.1±0.31	7.4±0.27	8.4±0.23
	Jaya	8.7±0.19	5.6±0.46	7.3±0.29	7.9±0.30
	BJ1	13.4^{c} ±0.27	12.6±0.37	13.7^{c} ±0.21	13.1^{c} ±0.25
	IET.4141	10.6^{d} ±0.25	10.1^{d} ±0.29	10.2^{d} ±0.28	10.8^{d} ±0.29
Grains per panicle	IR8	193.6±2.68	183.8±3.16	188.1^{e} ±4.21	190.6^{e} ±3.10
	Jaya	283 3^{f} ±3.82	266.3±2.80	278.1±3.64	284.3^{f} ±3.06
	BJ1	178.4^{g} ±2.46	176.8^{g} ±2.72	178.2^{g} ±2.50	176.8^{g} ±2.10
	IET.4141	182.7^{h} ±3.49	178.4^{h} ±3.10	179.5^{h} ±3.21	184.8^{h} ±3.12
Chaffy grains per panicle (%)	IR8	4.8±0.42	20.9±0.21	15.7±0.29	15 8±0.34
	Jaya	3.9±0.26	20.6±0.19	14.3±0.21	11.1±0.48
	BJ1	4.7±0.32	13.2±0.25	7.0±0.28	6.7±0.42
	IET.4141	4.0±0.61	11.7±0.27	6.7^{i}±0.23	6.6^{i}±0.36
*Specific density of grains	IR8	1.20±0.01	1.01±0.01	1.06±0.01	1.12±0.01
	Jaya	1.21±0.01	1.07±0.01	1.12±0.01	1.13±0.01
	BJ1	1.23^{j}±0.01	1.20±0.01	1.21±0.01	1.23^{j}±0.01
	IET.4141	1.23±0.01	1.16±0.01	1.81±0.01	1.02±0.01

*Mean value of 5 observations, ± represents standard error values, Mean Values followed by same alphabet do not differ at 5 P level of significance as determined from Duncan's multiple range test.

and pathogen interferes with the transport of photosynthates and nutrients. When the plants are blighted, two events follow, namely, a reduction in active photosynthetic area and the interference of vascular transport, resulting in impaired grain filling process. Thus, the yield loss by bactrial blight is due to reduction in photosynthesis and impairment of transport of photosynthates from source to sink. 'Fertile grain number' is the major grain yield component which is reduced drastically after bacterial blight infection. Therefore, breeding for increased fertile grain number rather than for heavy grain weight has to be considered for breeding bacterial blight resistant rice cultivars. This appears to be possible as the yield component 'fertile grain number' has high genetic co-efficient of variation, heritability and genetic advance[6].

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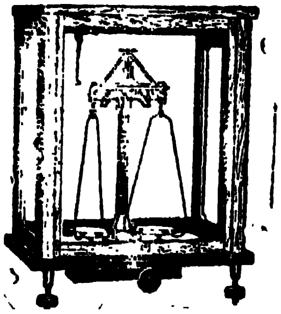

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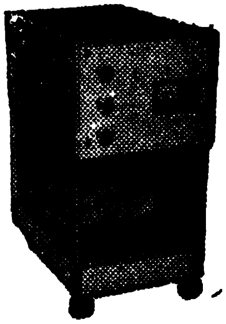

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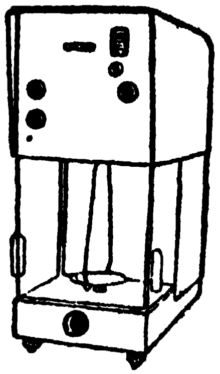

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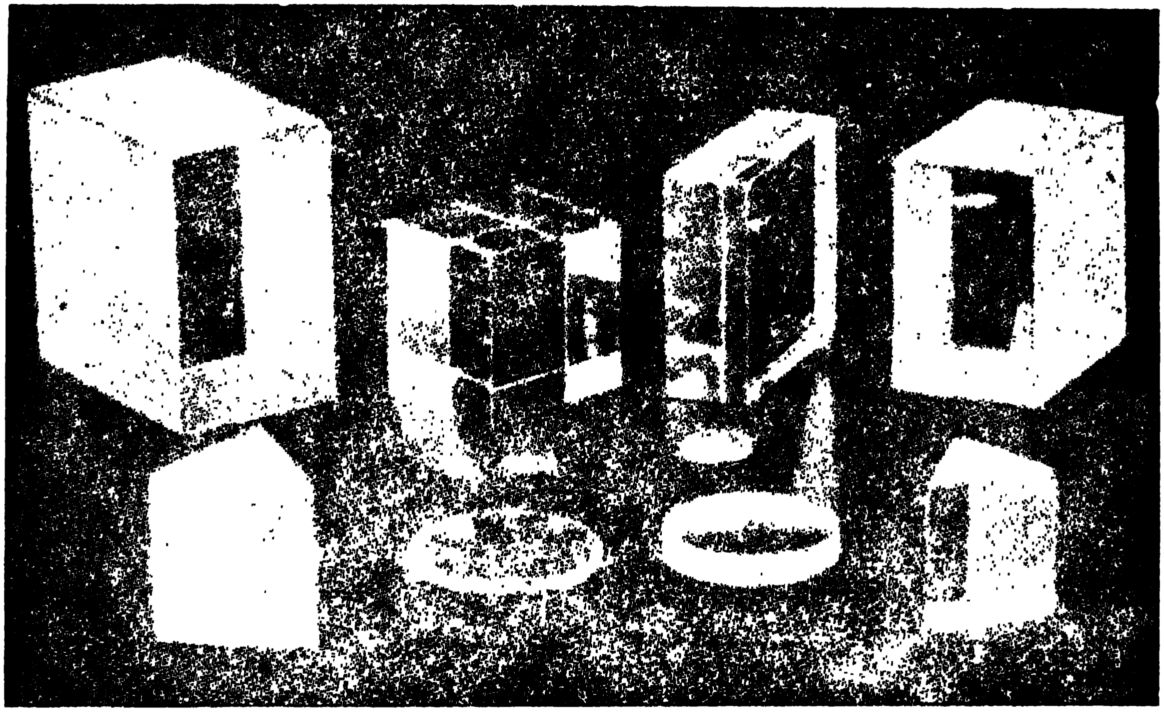

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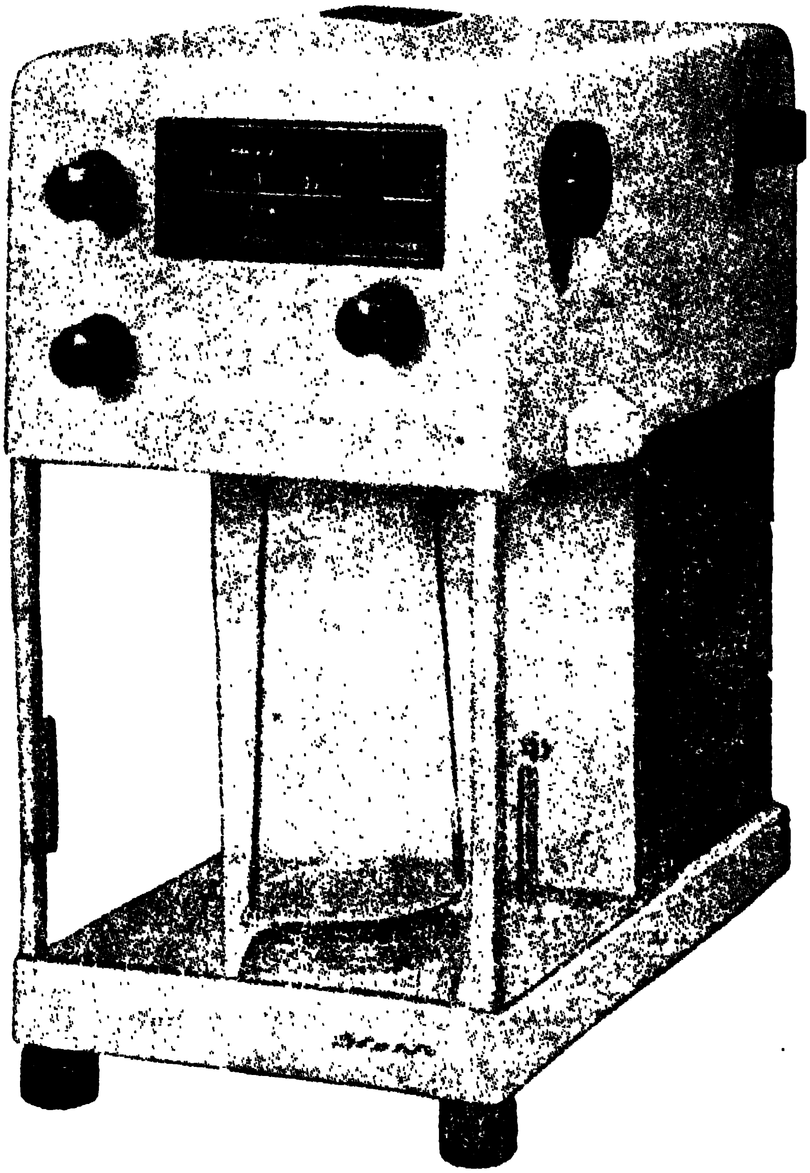

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FIFTY YEARS OF NATIONAL INSTITUTE OF INDIA (INSA)

THE desirability of starting an All India Academy of Science, which will be regarded as the representative organisation of the Indian scientists was put forward by Prof. M. N. Saha in his address as the President of the 21st session of the Indian Science Congress Association meeting held in Bombay in January 1934. After due deliberations, the Joint Committee of the Indian Science Congress Association unanimously accepted the proposal for the formation of a national scientific society. The joint committee formed an Academy Committee, which was requested to submit a detailed report for consideration at the next session of the Indian Science Congress Association. The Committee submitted its report in January 1935 incorporating the following :

(i) The aims and objects of the Academy ;
(ii) its draft constitution ;
(iii) names of 125 Foundation Fellows selected by a special Committee of specialists ; and
(iv) name of 25 scientists as members of the provisional council of the Academy.

The report of the Academic Committee was placed by Dr. L. L. Fermor, President of the 22nd session of the Indian Science Congress Association before a special meeting of the Joint Committee on January 3, 1935. The recommendations of the Academy Committee were accepted by a unanimous resolution by the Indian Science Congress Association and the foundation of the National Institute of Sciences of India as an all-India body of scientists was thus laid. An inaugural meeting of NISI was held on January 7, 1936 under the Chairmanship of Dr. J. H. Hutton, president of the 23rd session of the Indian Science Congress Association in Calcutta, and the inaugural Address was delivered by the first president of the NISI by Dr. L. L. Fermor.

The Institute started functioning with its Headquarters at the Asiatic Society of Bengal, 1, Park Street, Calcutta from that day with Professors M. N. Saha and S. P. Agharkar as Secretaries. It was named National Institute of Science of India on the French model after L' Institute of which academies were branches.

The issue of the Government recognizing NISI as the representative body of the scientists was taken up after ten years of its foundation. After due deliberations and discussions, it decided to recognize the National Institute as the premier scientific body of Science in India in October 1945. The Headquarters of the National Institute were moved to Delhi in May 1946 and the Government Commenced providing increased grants to the Institute to meet expenses on travel, publications, research fellowships and for allocating grants-in-aid to other societies for bringing out their publications. A capital grant for the Headquarter building was also sanctioned in 1948 by the Indian Government.

The foundation stone of the building was laid by Pandit Jawaharlal Nehru, the then Prime Minister of India on April 19, 1948. On completion of the building in 1951, the

National Institute of Sciences of India moved to its present premises on Bahadur Shah Zafar Marg, New Delhi. The National Institute of Sciences of India was designated as the adhering organization in India to the International Council of Scientific Union (ICSU) on behalf of the Government of India in January 1968.

The name of the National Institute of Sciences in India was changed to the Indian National Science Academy, (INSA) in February 1970.

The Academy consists of Fellows and Foreign fellows. The scientists are elected to the Fellowship of the Academy on the basis of their eminence in and contribution to Science and Technology. In recent years, the number of Fellows elected each year has been limited to a maximum of 30, till such time the total number reaches 700. The number of Foreign fellows elected each year is limited to the maximum of 8 and the ceiling on the total number of Foreign Fellowship is 100. At present (January 1984) there are 516 Fellows and 88 Foreign Fellows on the Academy's role.

The objectives of the Academy are the following :

(a) To promote the development of natural knowledge in India including its practical application to problems of national welfare ; to effect Co-ordination between Scientific academies, societies, institutions and Government scientific departments and services.

(b) To act as a body of scientists of eminence for the promotion and safe-guarding of the interests of scientists in India and to represent internationally the scientific work of India.

(c) To act through properly constituted National Committees in which other learned academies and societies will be associated as the National Research Council of India for undertaking such scientific work of national and international importance as the council may be called upon to perform by the public and by the Government.

(d) To publish such proceedings, journals, memoirs and other publications as they may be found desirable.

(e) To promote and maintain liasion between Science & Letters.

(f) To do and perform all other acts, matters and things that may assist in, conduce to, or be necessary for the fulfilment of the above-mentioned aims and objects of the Academy.

Since 1950, the Academy has been conferring medals and awards to eminent scientists in various disciplines. During the past 33 years, 85 lectures have been delivered. The Academy has brought out, on the occasion of its Golden jubilee, a compendium of these lectures. Since 1974, the Academy also instituted a scheme of Science Academy Medal to young scientists (below 32 years of age), with a view to honouring, talented young scientists for their notable contributions in specialised branches of Science & Technology.

To encourage participation of a large number of young scientists below the age of 35 years, the Academy, in collaboration with ICSU body—the Committee on Science & Technology in Developing Countries (COSTED)—has launched a programme of providing travel support to young scientists under INSA-COSTED Travel fellowship grants.

The number of scientists deputed for participation in international conferences abroad during last year was more than 250.

The Inter-Academy Exchange programme has progressed considerably since its inception in 1971. Presently the Academy has exchange of scientific programme with the Royal Society, London ; the U. S. S. R. Academy of Sciences ; the Japan Society for the promotion of Science, Tokyo ; the Hungarian Academy of Sciences, Budapest ; the French Academy of Sciences, Paris, the Polish Academy of Sciences, Warsaw and the National Academy of Sciences and Technology, Phillipines. Since 1982, exchange of visits of Scientists has been taking place regularly with the Chinese Academy of Sciences, Beijing. Visits of Scientists are also taking place with other neighbouring countries like Sri Lanka, Bangladesh, Nepal, Thailand, Singapore, Malayasia, Pakistan etc.

The Academy through its Fellowships attempts to inculcate and foster scientific temper in different walks of life in the country. The INSA tends to uphold the basic level of Science—search for truth and alleviation of human suffering.

The inauguration of the Golden jubilee year celebrations of the Academy was made by Shrimati Indira Gandhi, Prime Minister of India at Vigyan Bhawan, New Delhi on January 16, 1984. ☐

S. D. Chatterjee

RESEARCH AND DEVELOPMENT IN INDIA

C. C. KARTHA*

AFTER India attained independence in 1947, a considerable attention has been given to the development of scientific and technological capabilities of the nation, simulatneously with the industrialisation of the country. For this purpose a large number of research and development organisations were established in the country to work in areas of national interest. As a result, India today possesses a vast network of scientific and technical institutions of world standard and a large industrial sector producing practically every item required for the nation. Having established a large number of national laboratories and having built up a strong R & D infrastructure in science, technology and industry, modern India enjoys probably the tenth position amongst the industrialised countries in the world; and is a leading nation among the developing countries. Yet, inspite of various Five Year Plans implemented by government for the eradication of poverty and development of self-reliance, it is indeed unfortunate that the benefits of modern technology have not percolated down to the towns and villages to enrich the quality of life of the rural population.

India is basically an agricultural country with about 80% of the people living in the villages. An overall progress of the country will not be possible unless and until the weaker section of the population living in far remote villages and backward areas are also able to reap the benefits of scientific and technological progress.

For a developing country like India in order to become economically self-reliant, it is essential to establish a sound technological base, which is possible through rapid development of industries and building up of a strong R & D infrastructure to sustain them. For effective coupling of these two sectors, however, the via media of technology transfer operations become equally important. The creativeness of industries is judged by the way they can implement R & D results, through the purposeful process of technology transfer, into commodities that go to enrich the human society.

The R & D base in India is vast and covers every sphere of science and technology. Research in India is carried out primarily at National, state, public and private industries, universities and higher technological institutions. At the national level, the bulk of research is carried out by CSIR, a well-knit, coordinated, action oriented network comprising about 38 research laboratories spread throughout the country, covering the whole gamut of research and development activity. CSIR's expertise and experience is embodied in about 4300 active scientists and technologists, supported by over 10,000 scientific and technical personnel and an infrastructure build over the years at a present day replacement cost of approximately Rs. 1000 crore. The present annual budget is over Rs. 110 crore. Today over 90% of the expenditure on R & D in India is incurred by government agencies. About 10% of nation's science graduates are engaged somewhere in R & D, and a high proportion of engineers in project and development work. As a result of these efforts a large number of technologies relevant to the economic needs of the country have emanated from indigenous R & D institutions.

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There are mainly four phases of the goals of R & D in the country : (a) Creation of infrastructure, (b) Import substitution and export promotion, (c) Attainment of self-reliance and (d) Science for the people.

If the R & D policy is a reflection of social goals set by a society, then the research programmes have to take into account these linkages. It is the task of the managers of various R & D establishments to see the harmony between the research programmes with R & D policy and social goals.

Developed countries need sophisticated technologies to reduce high labour costs and mass production of goods to meet large markets. Such technologies are not appropriate to the needs of the developing countries, which have vast natural resources yet to be exploited, but are faced with the problems of massive poverty and unemployment, lack of capital resources, scarcity of educated and skilled manpower and very limited markets. Hence, any technology offered to the developing countries should be simple, easy to implement more labour oriented, less capital intensive, and in addition, as far as possible, should utilise local resources and should be capable of improving the living conditions of people in the rurual areas.

R & D can result in a new discovery or a new process, but its transformation into applied uses for the benefit of the common man calls for many more inputs, such as identification and promotion of entrepreneurship, the ready availability of desing and engineering services, the testing and training facilities for the operational staff and the marketing skills needed to carry the fruits of research to the consumer.

In so far as the imported technologies are concerned, although they produce the intended results, they do not contribute to the growth of the indigenous science and technology base.

In the field of pesticides, a coordinated and concerted development work for organophoshorous pesticides has helped in establishing several pesticide plants in the country.

In the area of drugs and pharmaceuticals emphasis was given both on the synthesis of entirely new drugs and their intermediates. The expenditure of the drug industry on R & D has almost doubled to Rs. 29.3 crore during 1978-79 to 1981-82 representing an increase from less than 1 5% to over 2% as a proportion of turnover. The number of R & D laboratories approved by the Union Government has increased from 40 in 1978-79 to over 70 now. There are about 10 companies whose R & D expenses exceed Rs. 1 crore a year. CSIR processes developed for ibuprofen, salbutamol, vincristine and vinblastin are being used by CIPLA. Besides, an improved process for vitamin B6 and rutin, a wide range of allergenic extracts for diagnostic and therapeutic use have also been developed. Aminophylline and theophylline were manufactured for the first time in India based on National Chemical Laboratory know-how.

Regarding the drugs discovered in India, the first drug to be discovered in India was urea stibamine in 1922. Next was methaqualone, synthesised by Regional Research Laboratory, Hyderabad. The third was hamycin, an antibiotic developed by Hindustan Antibiotic, Pune. Enfenamic acid, a completely new non-steroidal anti-inflammatory and antirheumatic drug, was the fourth new drug, synthesised and developed by Regional Research Laboratory, Hyderabad and marketed as tromaril by Unichem Laboratories. The fifth new drug to be developed in India was Hindustan Ciba-Geigy's sintamil (nitroxazepine). In addition several other new chemical entities having potential therapeutic promises are at present at various stages of clinical trial.

India abounds in natural resources. It is a common knowledge that when once a technical know-how is developed for a drug it spreads like wild fire and we find that a number of units coming up to manufacture the same product, setting up an unhealthy competition, ethical values apart. It is hightime that the well established units strive to carryout result oriented research to exploit the naturally occurring indigenous raw materials which lowers the burdens of competition and risk.

Biotechnology will increasingly be crucial to the solution of our problems of food, production, disease prevention and cure, population stabilisation as also providing technologies for higher efficiency, industrial material conversion and processing. The CSIR is strengthening its existing institutions working in biotechnology and is setting up a new institution solely devoted to microbial technology at Chandigarh. □

GUR AND SUGAR FROM PALMS IN INDIA

SATYAWATI SHARMA AND PADMA VASUDEVAN*

PALM tree was known to man as a source of sugar since time immemorial. Palms are found widely spread over the entire globe but are especially prevalent in the tropical and subtropical regions. In fact, there is an area designated as "Palm belt" of the world which extends upto 45° either side of equator. They belong to a large Family palmae estimated to be comprising over a thousand species. Palms like palmyrah, coconut, date, sago and nipa are sugar yielding.

In India, there are four such varieties of palms, the most important being (1) coconut palm which is valued for its nuts. Then comes (2) the palmyrah palm widely found in the southern states, West Bengal and other parts. (3) The date palm is found largely in the subtropical belt. (4) The fourth variety, namely sago palm is restricted only to certain heavy rainfall areas. While the palmyrah and date palms are widely tapped and exploited under the programme of Palm Gur Industry, the coconut palm is tapped for gur making only in Coimbatore district of Tamilnadu and sago palm in a much smaller scale in Kerala. At the present it is estimated that about 8 crores of date and palmyrah are available in the country in addition to about a crore of Sago palms. Out of this, 5 crores of palms are estimated to be tappable but only about 1.00 crore are at present reported to be utilised partly for neera, palm gur and other palm products.

Preparation of jaggery and Sugar from the sweet sap of palm was known to Indians from ancient times. It is reported that the first sugar factory to be established in India was for making palm sugar and was installed in the year 1837 at Dhoba near Burdhwan in Bengal.

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Indian Varieties of the Palm

Coconut Palm (Cocos nucifera): It is cultivated in damp regions of India near seacoast. Almost every part of the plant is useful and it yields a large variety of products. The endosperm of young fruits is eaten and the milky fluid makes a refreshing drink. The ripe dried endosperm is a valuable source of a vegetable fat which is used for cooking, mar-garine, soaps, hairoils and shampoos. The oilcake left is used for fattening cattles. The fibrous mesocarp is the source of coir, used for the making doormats, floorcoverings, ropes, brushes and for stuffing Sofa, chairs, beds, etc. The woody endocarp is made into several decoration articles. The infloresence when young is tapped for toddy which on fermentation gives an intoxicating alcholic drink. The leaves are used for making fans, baskets, mats etc. and also for thatching. The stem is used for posts, pillars and as a fuel. The large terminal bud is used as vegetable.

Palmyrah Palm (Borassus flabellifer): Palmyrah fibre is obtained from the palmyrah palm of East India. This species is one of the most useful of the palm, all parts of plant being used for some purposes or other. The fibre are made into roap, twine, paper and machine brushes.

The juice of several species of palms is a source of commercial sugar. The sap is obtained from the unopened infloresences. Usually the tip of these is cut off and sap oozes out and is collected in various sorts of containers. The yield of this sweet juice, which is known as toddy, amounts to 3 or 4 quarts a day for a period of several months. The sap has a sugar content of about 14%. It is boiled down to a syrup and poured into leaves to cool and harden into crude sugar known as jaggery.

The toddy is often fermented to make the beverage known as arrack (palm wine).

Date Palm (Phoenix spp.): It can grow with less water than any other crop and so is of utmost importance to desert peoples. It is distinctly a plant of hot sunny climate with low humidity. The favourite habitat is the oasis.

The fruit of this, a nearly round drupe or one seeded berry is hard and green at first but later turns yellow or red. This genus has many species, in which two (*Phoenix dactylifera* and *P. sylvestris*) are found in India. Large number of species are growing in Nigeria and Iraq. The fruits of *Phoenix sylvestris* have a inferior quality of food value and are dry, hard while in *P. dactylifera* they are rich in pulp and have a high food value and sweet and thick. They are propagated by seeds or cuttings. Fruits have a high food value, with 54% sugar, 7% protein as well as pectine and gums.

Dates are used as a taple fruit and in jams, pestes, cooking and alcoholic beverages and sugar. The leaves are used for fans, mats, baskets and for thatching. Roots and root-off shoots also have carbohydrates and sugar. Fibres from leaf stalk are thin and strong used in roap, twine, paper and machine brushes.

Neera or toddy is obtained by tapping the upper portion of stem. From which we can obtained sugar (jaggery) and on fermentation gives arrack. Plam gur is manufactured by concentration plam juice.

Sago palm (Metroxylon sagu): The sago palm is the most beautiful palm that can yield 44 kg to 88 kg of jaggery per year continously for a period of 3 to 7 years. It is growing in gardens as an ornamental tree but few people know its value. Palms can grow on all waste and uncultivable lands and can wholly produce all the sugar and gur needed.

Date, Palmyrah and Sago palms are a boon to a developing country like India. They grow on waste lands requiring hardly any manuring or irrigation. The palms are mostly free from diseases. They can be easily grown on bunds of fields, river, banks, dryland canals and roadsides. The palms are wind breakers and protector of standing crops from gusty winds.

Rearing the Palms

By giving cultural and manurial treatment to palms, we can increase the yield of neera per tree per season to three times its normal yield. In addition to the increase in the yield, there is also an increase in sucrose content. These treatments are capable of changing the fundamental nature of palms practically in the physio-chemical characteristics of palms. On an average the date palm yields the lowest minimum of 11 kg of gur per season, whereas it is capable of yielding twice that with watering and manuring. On an average the palmyrah palm yields 22 kg of jaggery ; but it can respond to treatment to yield 22 kg to 44 kg of gur with proper cultural treatment.

Plantation

Capable of meeting our Sugar and Gur demand : The palm seedlings are first scientifically planted in nurseries, in earthen or bamboo pots and when they sprout they are transplanted into pits specially prepared for this purpose. The distance between the pits varies from 12 ft. to 18 ft. according to the nature of the soil and environmental conditions. Composite plantation units of palms of all varieties can also be envisaged. With systematic, composite palm plantation on waste lands, if started now, at the end of the next 15 years, we shall have over 80 crores of palm trees of a variety alone or mixed variety. These will be capable of yielding all the sugar and gur we shall need then. This is based on the following data :

Each acre is to be planted with 1000 trees. The date palms begins to be yield in the 8th year, the palmyrah and sago begin to yield in the 15th year. If all the 1000 trees were to yield juice, at the lowest capacity, the total yield per acre will be :

1,000 date palm tree alone, 11 kg : 11 tons
1,000 palmyrah palm trees, 22 kg : 22 tons
1,000 sago palm tree, 44 kg : 44 tons.

Such an ideal goal may not be reached but we can certainly hope to net at least half of what these figures show. Therefore, at the lowest yield, an acre of dates, palmyrah and sago are capable of yielding respectively 5.5, 11 and 22 tons of gur and sugar per season. In addition to neera palm sugar (jaggery) and palmy gur other products like palm candy, palm cola and palm syrup are also manufactured under the programme. Palm syrup generally prepared by concentrating neera. This syrup is consumed directly or used for making food preserves. Palm gur also found to be a good and nutritious sweeting base for a number of confectionery and sweetmeat items. Palm cola and beverage has been evolved using palm sugar as the base.

Palms are also valuable for their non-edible products. Neera and palm gur are known for their nutritional qualities. They constitute a good source of some of the essential B vitamins, ascorbic acid, iron and calcium. It is a known habit among village folk to take palm gur with water before attending to strenuous work in the fields. Even in ancient medicinal system the value of palm gur and palm juice had been recognised.

Both palmyra and date palm can be considered potential sugar yielding trees, if compact plantations are raised. It is estimated that a hectare of land would be able to raise a plantation of about 1,600 palms which in turn would ensure 25 tons of gur per season. A systematic programme in exploiting the available and tappable palms in the country together with raising of palm plantations would not only meet the growing requirements of sugar for the nation in the years to come but also provide a large scope for rural employment. ☐

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MARINE FISH—A GREAT POTENTIAL FOOD SUPPLY[*]

P. N. SEN GUPTA[**]

MAN knows less about the mysterious depths and floors of the oceans although his world is covered by 71 per cent of broad expenses of water and the oceans and contingent seas influence man in many ways particularly the climate he experiences, the oxygen he breathes and the foods he eats. To him, the three most important available resources from the oceans are (1) Minerals, (2) Energy and (3) Food.

Minerals : One of the most valuable resources in the oceans are the black potato-sized mineral-rich *nodules* that carpet ocean floors at depths between 5000-6000 meters. The principal components are manganese (29%), iron (6.3%), nickel (1.28%), copper (1.07%), cobalt (0.25%) as also molybdenum, lead, zinc and possibly uranium[1].

Energy : Off-shore drillings of the oceans made several Arab countries prosperous with enormous production of petroleum products. Such efforts in the Arabian Sea near Bombay coast known as 'Bombay-High' are raising expectations of India's self-sufficiency in this energy yielding valuable petroleum products.

Food : From pre historic periods upto the modern times, the oceans and seas are serving as source of food, mainly fish, large and small, crustaceans and molluscs including some nutritionally important sea weeds. Although there may be great expansion of man's uses of sea yet food production will remain most important[2]. With technological advancement, the man's hunt for food from sea is constantly increasing for his survival. It appears that the introduction of trawlers or factory boats and judicious management based on scientific and technological advancement will yield from sea limitless food to feed the generations.

Aquaculture : Economically promising scientific technique for exploring the sea to meet human needs is through controlled fish farming known as *Aquaculture*, a highly specialised technique now in operation in several countries' ocean coasts[1,3]. Salmon and similar varieties are being cultured on both the Atlantic and Pacific coasts and marine shrimps in many coastal areas.

Application of Space Science : The Oceanographic Satellites introduced in 1970 decade ushered a new era to study the ever changing ocean phenomenon. The principal beneficiary of the information derived is the fishing industry. These satellites augment traditional marine biological research techniques and answer to the problems of commercial fishing, such as : where fish are likely to be found, how large the potential catch will be and how rough the sea is and also information on the distribution and habits of the habits and lives in the sea[3].

World Fish Production

The estimated regional and world catch of marine fish from 1948-52 to 1964 (in million tonnes) were as follows : Western Europe 6.3 and 8.8 ; Oceania 0.09 and 0.1 ; Latin America 0.60 and 11.6 ; Far east 6.85 and 11.9. World total 20.7 and 44.8. The increase in Peruvian production has been major factor in the recent expansion of the world catch[4]. Comparative productions in nine countries for the years 1948 and 1965 shown in Table 1 reveal the changes in production trends. Nevertheless, fish available for consumption do not reflect the same trend as production[5,6].

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[*] Presented at a Session, 70th Indian Science Congress, Tirupati, 1983.

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TABLE 1 : Total live weight catch (Fish, Crustaceans, Molluscs)—comparative productions and consumption

Country	Productions (000 Tonnes)				Consumption (g/caput/day)
	1948	%	1965	%	1965
WORLD TOTAL	19,500		51,600		
Peru	84.1	0.4	9,130.7	17.7	19.7
Japan	2,518.5	12.9	6,334.7	12.3	76.2
U. S. S. R.	1,485.0	7.6	4,475.8	8.6	—
U. S. A.	2,416.6	12.4	2,547.1	5.1	13.1
Norway	1,502.2	7.7	1,608.1	3.1	55.3
Canada	1,052.9	5.4	1,211.1	2.4	—
Spain	547.2	2.8	1,203.5	2.6	38.1
India	681.5	3.4	1,370.0	2.6	2.6
U. K.	1,206.1	6.2	974.6	1.9	28.0

Development of Fishing Industry in India

Fish production : India experienced tremendous growth in fish industry during the last two decades : 0.75 and 2.54 million tonnes respectively in 1951 and 1977. Increase from 1951 to 1977 : World catch 284% ; India 338%, the latter was about 3.5% of world catch[6]. Two technologies were introduced during this period, namely, (1) mechanisation of fishing fleets for shrimp trawling and (2) the freezing and cold storaging of frozen fish[7]. Fish is cheaper source of animal protein in man's diet. Fish contributes about 12% of annual world consumption of animal protein. In India, its consumption is 2.7 gm per caput/day. Panikkar[8] estimated that by the year 2000, India will require 11,410 thousand tonnes of fish on a minimum basis. Since India achieved phenomenal growth in fishing industry, it is becoming possible to provide more protein-rich foods to millions, provide employment to large number of population and earn over two hundred crores annually in foreign exchange.

Two Types of Fisheries : Two types of fisheries operate on the Indian coast, namely (1) pelagic and (2) demarsal[7]. 90% of marine fish catch comes from in-shore waters. *Pelagic*: This is exploited within the coastal region of less than 50 meter depth. Oil Sardines, Mackarel and Tuna are the main catch the production of which showed fluctuating trends, such as (in 000 tonnes) : 1969: 266.086 ; 1974: 164.138 ; 1977: 212.266 and 1978: 253.311. *Demarsal*: These are caught near the bottom of the sea with highly mechanised technique. Average annual catch is 0.6 million tonnes of shrimp and prawns which accounts for 87% of foreign exchange earning from marine products.

Deep-sea fishing is not as rich as the in-shore waters which provides 90% of fish catch. Per hour's efforts, the depth zone 93-128 meters (50-70 Fathoms) gave highest yield (542 kg), followed by 55-91 meters (30 50 Fathoms) : 407 kg and 136-366 meters (71-200 Fathoms) : 272 kg. Economically, the latter is more profitable despite lower catch per hour[9].

India's fishing efforts : India is now second largest fishing nation in the developing countries and seventh in the world. India continues to top the list among the shrimp producing and exporting countries. This industry employs over four million people in various sectors and therefore has significant bearing on social and economic life of people in several states besides valuable foreign exchange earner, Japan is the largest buyer of frozen shrimps followed by U.S.A. They share 90% of shrimp export, remaining 10% are shared by 24 european countries. The export in 1971-72 was valued Rs. 59.72 crores whereas in 1981-82 the export rose to 94,535 tonnes valued at 286.01 crores. Japanese consider shrimp a sacred item and it is a "must" in marriage ceremony.

Fish production, export and availability : Year-wise production of total and marine fish, export and consumption from 1951 to 1978 are shown in Table 2[6]. Even with the increase of total fish catch, percentage of production of marine fish remained almost the same. The export of marine fish has considerably increased from 1975. The availability of fish for local consumption increased from 5.0 gm in 1951 to 10.5 gm in 1978. It will be of interest to have information on the consumption of fish in several states[10]. Kerala tops the list with 29 gm followed by West Bengal, 8 gm; Karnataka, Andhra Pradesh, 6 gm; Maharashtra, Gujarat, 4 gm per caput/day.

TABLE 2 : Average production of fish in India, export and consumption

Year	Total production (000 Tonnes)	Marine fish %	Export	Consumption (g/. caput/day)
1951	751	—	19	5.0
1960	1,161	—	18	6.6
1965	1,332	62.5	—	7.4
1970	1,748	61.0	34	7.8
1975	2,328	61.2	106	9.4
1978	2,760	62.7	156	10.5

Average chemical composition and amino acids contents. Average chemical composition and amino acids contents of fish shown in Table 3 reveal that marine fish is nutritionally better than other similar species having higher protein and fat contents, so also calcium and iron contents and provides higher calories. Even in essential amino acids contents of proteins, marine fish is superior due to high lysin, total sulphur containing amino acids, total essential amino acids and protein score[11].

Importance of marine fish in human nutritions[12] : (1) Marine fish is a closely related food of variable composition. (2) Marine fish proteins have high Biological Value (BV) 80.0-88.8%. (3) These are good sources of minerals and vitamins. (4) Their high lysin and methionine as also tryptophan are valuable supplements to high cereal diets. (5) The high levels of polyunsaturated fatty acids in some fish oils are likely to keep down cholesterol levels of blood. (6) Although marine fish provide about 12% of animal protein, yet these have special potential in nutrition. (7) exert *catalytic effect* in increasing the overall protein quality of the diets. (8) Marine fish are reliable

TABLE 3 : Average chamical composition and amino acids contents of marine fish (Per 100 g edible portion)

	Inland fish	Marine fish	Shrimp	Crustaccans		Molluscs
				Lobstar	Crab	Turtle meat
Protein g	19.1	19.5	17.3	16.9	17.3	15.2
Fat g	1.6	9.9	0.2	1.9	1.9	6.3
Calories	109	172	86	91	93	115
Calcium mg	312	340	94	29	43	62
Iron mg	0.9	2.3	1.6	0.6	0.8	1.1
Nitrogen g	2.46	3.01	2.77	2.56	—	1.60
Lysin (mg/g N)	—	577	—	493	—	498
Tryptophan ,,	—	70	—	71	—	81
Total 'S' contg. amino acids	—	253	—	261	—	250
Total essential amino acids	—	2813	—	2722	—	2830
Protein score	—	80	—	65	—	71

sources of both iodine and fluorine and appreciable source of iron. (9) Possibility exists that increased marine fish consumption would entail improving health and preventing diseases and these have significant in decreasing disability and death from coronary heart diseases.

Greater attention needed in educating the consumers to promote wider use of marine fish for maximum benefit of present scientific and technological knowledge. □

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NOTES & NEWS

Golden Jubilee Celebrations of the Indian National Science Academy

The Golden Jubilee Celebrations of the Indian National Science Academy, New Delhi was held during 16-18 January, 1984 at New Delhi. The Academy is recognised as the premier scientific society representing different branches of science in the country. It is the adhering organisation in India for the international council of scientific unions, and of the international scientific unions affiliated to international council of scientific unions on behalf of the Government of India. The Academy's objectives are (1) to promote knowledge in India including the practical applications to problems of national welfare, (2) to act as a body of scientists of eminence for the promotion and safe-guarding the interest of scientists in India, (3) to act as the national research council for undertaking scientific work of national and international importance, (4) to publish proceedings, journals, memoirs and other publications, and (5) to promote and maintain the liaison between Science and Letters.

The Academy, established in 1935, is completing its 50th year in 1984. Inaugural function of the Golden Jubilee Celebrations was presided over by Prof. A. K. Sharma, the president of the Academy at Vigyan Bhawan, New Delhi on 16 January, 1984. The publications of the Academy during the Jubilee Year and the unveiling of the model of the Golden Jubilee Building was performed by the Prime Minister Smt. Indira Gandhi. The famous aviator and benefactor Sri B. N. Roy of Calcutta donated one lakh of rupees for this building and has promised to give subsequently another eleven lakhs of rupees.

A special feature of the celebrations was the presence of representatives of collaborating foreign academies and adhering organisations from all over the world. They were warmly welcomed by the president of the Academy and Jubilee Plaques were presented to them. Such plaques were also presented to the foundation fellows, two of whom namely, Prof. K. R. Ramanathan and Prof. W. D. West were present at the ceremony; the other two living foundation fellows, Profs. S. Chowla and N. R. Dhar, could not be present. Jubilee plaques were also presented to past presidents of the Academy and present presidents of the Asiatic Society of Calcutta, the National Academy of Science, India, Allahabad and Indian Academy of Science, Bangalore. It may be recalled that in Harvard University, U. S. A., during a graduation ceremony, the oldest living graduates of the University lead the procession of graduates to the dias.

On the next day, January 17, 1984, the 5th Blackett Memorial Lecture was given by Sir Andrew Huxley, N. L. president of the Royal Society of London who was also a student of Prof. Blackett. He narrated in detail Prof. Blackett's research in various fields and his political affiliation. A lecture on Science and Politics was delivered by Prof. M. G. K. Menon, immediate past president of the Academy who described his group's notable work at Kolar gold mine for determining the life time of proton. On the last day i.e. the 18th January, 1984, a very interesting talk by Dr. D. S. Kothari, a past president, was presented.

The presidents of foreign collaborating countries presented their research activities or narated how research is being conducted in their countries. On 17th January the presidents of the academies of China, France, Hungary, Japan, Norway, and on the last day those of Philippine, Poland, USA and USSR presented their talks. It is interesting to note the remark made by Japanese president which is briefly given below.

In recent years Japan has technologically improved to a great extent. Scientists and technologists from all over the world visit Japan to understand their technological superiority. This improvement is contributed by two factors working in the same direction.

First, in Japanese universities, great emphasis has been given in teaching engineering subjects which have been classified into a large number of divisions. Secondly, students after completing their engineering courses in universities are absorbed in industries and are allowed to work in their research laboratories where adequate facilities are provided for carrying out research. It was told by the Japanese president that about two-third of the country's research is now being carried in industrial laboratories. The work is not confined to development alone but to high grade applied and fundamental research too.

A drawback in carrying out research in industrial laboratories is that the authorities concerned may not like to publish findings obtained in their research laboratories or may delay them. This may not be the case if research is being carried out in universities or in research institutes.

Another special feature of the Golden Jubilee Celebrations was the presentation of research works by the candidates under consideration for the awards of Science Academy Medals for young scientists of 1984. It may be recalled that the Academy instituted the scheme of awards to young scientists in 1974. So far 146 young scientists have been selected for the award. The award carries beside a medal, a cash prize of rupees 5000/- to be presented by the prime minister each year in January at the venue of Science Congress. The award is considered as a signal recognisation of promise in research and is regarded as the highest award for young scientists in the country.

A large number of publications was brought out by the Academy during the Jubilee Celebrations of which two deserve special mention; namely, a book entitled 'Fellows of the Indian National Science

Academy, past and present' with their photographs and biographical notes. In this book, practically all eminent scientists of the country and some from abroad find place. Secondly, another book, 'Academy Medal for Young Scientists 1974-1983' was printed.

The Golden Jubilee Celebrations of the Indian National Science Academy presented a unique gathering of renowned scientists of the country and from abroad who discussed their findings about the frontiers of science and how best research could be carried out in future. ☐

S. N. Ghosh

A new organic nitrogen source

At the Division of Soil Science and Agricultural Chemistry, a comparative study of the release patterns of urea and hexamethylene tetra-amine (HMT), both organic N sources, showed that HMT mineralises in the soil as fast as urea, thus suggesting the possibility of the existence of enzymes, amine hydroloses in soil. HMT proved to be a more superior sources of N than urea in the maintenance of higher mineral nitrogen in the soil at all growth stages of wheat and its superiority was also confirmed by higher grain yield as well as percent N recovery. The study also indicated that a particular mineral N form may be important at a particular stage of crop growth, e.g. NH_4^+ —N was quite important during first 14 days ($r^{-0.894}$), whereas NO_3^-—N was not. After 14 days, NO_3^-—N also appears important and surpasses even NH_4^+—N. It may be further pointed out that ($NH_4^+ + NO_3^-$) is a better index of N availability than any of these individual forms. ☐

IARI Newsletter

New pregnancy detection test

Previously pregnancy could be detected only after implantation, when the placenta began to produce hormones, usually 10-12 days after fertilisation. It was belived that maternal recognition of pregnancy did not occur until this point. Australian researchers at the University of Queensland's department of surgery discovered a new hormone that will enable doctors to detect pregnancy within six hours of fertilisation.

Lebelled "the early pregnancy factor", the new hormone is produced by the mother and then by the placenta to allow the unborn child to grow. The hormone was expected to aid the work of in-vitro fertilisation teams. It would enable to monitor the egg after transfer to see whether it is growing correctly. Another use for the hormone was in the diagnosis of certain forms of cancer where it could act as a marker. ☐

Australian Information Service

New theory on headaches

Until recently, all headaches had been classified as migraine or tension. But this was because doctors had been taught to look for cervical (neck) headaches. A group of Australian researches believes it has uncovered a third common cause of headaches, arising from a series of small joints at the back of the neck.

Led by Nikolai Bogduk, Senior Lecturer in Anatomy at the University of Queensland, the work has been carried out at the Princess Alexander Hospital Pain Clinic in Brisbane. Others involved in the project include anaesthetist Tony Marsland and neurosurgeon Leigh Atkinson.

The researchers have focussed attention on the zygapophysical joints—seven pairs, each about the size of a knuckle, located between vertebrae at the back of the neck. By knowing the relationship of the nerves to the bones, their location could be pinpointed on an X-ray plate of the patients neck. The pain-causing nerve was then located through a process of elimination. While the neck joints were not the cause of all headaches or neck pain, in five out of seven headache sufferers tested this proved the case.

The team's work would provide relief not only for headache sufferers but also for people who experienced pain associated with whiplash and other back injuries. The new diagnostic methods were expected to help neck sufferers prove their cases in compensation and insurance claims. ☐

Australian Information Service

LETTERS TO THE EDITOR

On the effect of some physical factors on the activity of red pumpkin beetle, *Raphidopalpa foveicollis* (Lucas)

Red-pumpkin beetle, *Raphidopalpa* (*Aulacophora*) *foveicollis* (Lucas) (Coleoptera : Chrysomelidae) is a destructive pest of cucurbitaceous vegetables in India[1]. Studies on the biology, chemical control, differences in the injury caused by different species of *Raphidopalpa* have been made[2-4] but no ethological studies on *R. foveicollis* (Lucas) have been reported so far. The study was, therefore, initiated to observe the behaviour of the adult beetle, *R. foveicollis*, at different hours of the day and corresponding temperature, humidity and light intensity.

Long melar (*Cucumis* melo Linn. var. *utilissimus*) was sown on March 20, 1981 in an area of 15 m at the Research farm of the College of Agriculture at Gwalior. Observations on the adult beetle population of *R. foveicollis* was started from 21 April, 1981 and continued up to 27 April, 1981. The population of adult beetles was noted on upper and lower surfaces of 100 leaves at 2-hr interval starting from 6 am till 8 pm (Table 1). Light intensity, temperature and humidity on the two surfaces were simultaneously recorded. The data were statistically analysed.

Light intensity, humidity and temperatures govern the activity of the beetles (Table 1). The population was low on the upper surface of the leaf at 12 am and 2 pm when the light intensity ranged from 10,069

TABLE 1 : Effects of light intensity, temperature and humidity on the activity of adult beetles of *Raphidopalpa foveicollis*

Time of observation	Adult beetles/100 leaves				Light intensity (lux)		Temperature (0°C)		Relative humidity (%)
	Upper leaf surface		Lower leaf surface		Upper leaf surface	Lower leaf surface	Air	On upper leaf surface	
	Range	Mean	Range	Mean					
6 am	20-22	21.00	0-3	1.28	10,039	10,027	24.42	21.35	72.42
8 am	16-22	20.15	0-4	1.74	10,053	10,043	32.14	29.14	53.85
10 am	10-16	13.43	6-11	8.42	10,064	10,045	36.00	33.85	27.00
12 am	1-5	2.43	8-22	17.42	10,071	10,057	38.71	35.42	22.14
2 pm	2-5	3.58	16-19	17.85	10,069	10,053	40.00	37.00	20.14
4 pm	5-8	6.72	3-16	10.14	10,054	10,054	37.85	33.71	20.00
6 pm	13-22	16.15	1-6	3.12	10,023	10,018	34.57	31.38	25.00
8 pm	17-24	20.29	0-3	1.14	509	503	28.21	26.28	41.28
S Em ±		0.72		1.89			0.65	0.50	1.39
CD at 0.05		2.37		5.37			1.85	1.42	3.94

to 10,071 lux. Moderate population of beetles was recorded at 10 am and 4 pm when the respective light intensity was 10,054 and 10,064 lux. The adult beetles started migrating towards lower surface of the leaves at 10 am when the light intensity was 10,046 and the movement was in reverse direction at 4 pm when the intensity was 10,043 lux. The maximum population of the adult beetles on upper surface was at 6 am, 8 am and 8 pm when the light intensity ranged between 509 to 10,039 lux.

The beetles did not tolerate the light intensity above 10,057 lux and started migrating to the lower surface of the leaves, where they got tolerable light intensity between 10,053 to 10,057 lux during 12 noon to 2 pm. The population of the beetle was positively correlated with light intensity ($r=0.28$, $t=.744$; P 0.05), having 7.8% variability. However, the partial correlation coefficient between both population and light intensity vs temperature was negatively correlated, having 0.16% variability.

The adults remained most active on the upper surface of the leaf when the temperature of the leaf surface was 21.35 to 31.28°C and 24.4 to 34.57°C of the air. The temperatures above 33.85°C of the leaf surface and 36.0°C of air were not tolerable to the adults. Variation in air temperature and the beetle population on the upper surface at different times of the day was highly significant, with a negative correlation r value being -0.86 (P 0.01) and the variability value was 73.9%.

In case of *Raphidopalpa* population on 2 surfaces of the leaf, the relative humidity at different times of the day was most important. From morning with the progress of the day the humidity of the air decreased, the insects moved to the lower surface of the leaves and in the evening they again came up when humidity in the air around the creepers increased. This insect did to avoid dessication due to decreasing saturation deficiency of air during the day time.

It was concluded that the light intensity, temperature and humidity govern the diurnal activity of the adult beetles of *Raphidopalpa foveicollis*.

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A rapid technique for diagnosis of plant diseases by fluorescent microscopy

Fluorescent microscopy is based on the property of some substances to absorb lights of shorter wavelengths and become stimulated or excited and emit energy in the form of longer wavelengths of visible light as fluorescence[1]. This depends on the ability of the substances already having fluorophores or fluorochromes being added to it. This phenomenon of fluorescence could be exploited in various studies including detection of plant diseases. Detection of several mycoplasmal diseases of plants with fluorescent microscopy following differential staining and other techniques has been reported by several workers[2-6]. The present investigation was conducted to evolve a rapid and simple fluorescent microscopic diagnostic technique for a number of plant diseases caused by viruses, mycoplasma fungi, bacteria as well as deficiency diseases which are common in our country.

Uniform samples were collected from healthy as well as infected plants maintained in the glasshouse. Samples were also collected from supposedly infected plants in the field. Thin free-hand sections were prepared from leaf petioles and tender stems of fresh tissues. The sections were mounted in glycerine and observed under an Olympus Vanox fluorescent microscope, using mercury vapour lamp as light source, blue filter (B-1) as exciter and yellow (Y-50) and green (G-550) as barrier-filter combinations. Colour photomicrographs were taken on Agfachrome artificial light film (200 ASA) giving long exposures.

The following host-disease combinations were examined : tomatoleaf curl (virus), tobacco-mosaic (virus), *Dolichos*-yellow mosaic (virus), okra-yellow vein mosaic (virus), bitter gourd-cucumber mosaic (virus), Jute-leaf yellowing (virus), brinjal-little leaf (mycoplasma), sesamum-phyllody (mycoplasma), citrus-greening (mycoplasma), mustard-white rust (fungi), cauliflower-black rot (bacteria). Besides these, zinc deficiency in citrus was also examined. In all the cases, the phloem tissues in healthy leaf petioles and tender stems exhibited bright orange red to brick red autofluorescence, while those from plants infected with viruses and mycoplasma only showed yellowish green to green autofluorescence ; the bright orange red to brick red autofluorescence was partially or totally absent. Similar observations[7-8] were made in case of several mycoplasmal and yellows type of virus diseases. However, though the zinc-deficient leaves of citrus apparently showed the symptoms of greening, the petiole tissues exhibited brick red autofluorescence like the healthy ones. Similarly, the white-rust infected mustard and black-rot infected cauliflower tissues also showed brick red autofluorescence similar as in the case of healthy ones. In phloem tissues from plants infected with viruses and mycoplasma, the yellowish green to green autofluorescence was directly and bright orange red to brick red autofluorescence inversely proportional to the degree of disease development. This characteristic colour difference in autofluorescence is difficult to explain. This may possibly be due to accumulation of some specific fluorophores in the phloem tissues formed as a result of interaction between hosts and viruses and mycoplasma only which are different from those formed as a result of host metabolism only. In case of plants infected with fungi and bacteria as well as deficiency diseases, possibly no such fluorophores are accumulated in the phloem and hence no difference in the colour of autofluorescence.

In conclusion, this characteristic chromatic difference in autofluorescence might prove useful as a rapid and relatively simple method for detection and diagnosis of infection in plants particularly by viruses and mycoplasma-like organisms. This technique would be especially useful in indexing perennials like citrus, apple, etc., against viral and mycoplasmal diseases and in cases of quarantines where quick testing is necessary.

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Effect of mannitol on stomatal behaviour

Sugar alcohols (polyols) increase under moisture stress[1-3]. It has been suggested that these compounds which accumulate under moisture stress may have an osmoregulatory function[4]. The exact role of these polyols in water relation of plants subjected to moisture stress is still not clear. Work conducted in our laboratory has shown that mannitol-enriched plants showed reduced rate of water loss, higher leaf water potential and higher leaf diffusive resistance under moisture stress conditions. This suggested that mannitol may have a role in stomatal regulation. Experiments were, therefore, conducted to study the effect of mannitol on stomatal movement.

Epidermal peels of balsam (*Impatiens balsamina* L.) leaves were floated on medium containing BA (benzyladenine 2 ppm) and KCl (potassium chloride 75 mM) for 4 hr under light (2000 lux) to cause stomatal opening to the maximum extent. Such epidermal peels with fully opened stomata were then transferred to water or mannitol (0.125 M). The width of the stomatal aperture was measured at intervals after transfer, using an ocular micrometer. Isoosmotic solutions of PEG (Polyethylene glycol mol wt 6000) and mannitol were used in this experiment to examine if the effect was purely osmotic or otherwise. Epidermal peels were floated on isoosmotic solutions of PEG and mannitol at – 5 bars for 1 hr. The peels with closed stomata were then transferred to a solution containing 75 mM KCl and 2 ppm BA. The width of the stomatal pore was measured at different time intervals.

The width of the stomatal pore in the epidermal peels, pretreated with BA 2 ppm and KCl 75 mM and, transferred to mannitol, decreased and within 120 min, the stomata were completely closed (Fig. 1, Table 1). However, in epidermal peels transferred to water only, the stomata remained partially open even after 120 min (Fig. 2, Table 1). The effect of mannitol on stomatal closure was evident within 30 min after transfer from a medium of BA and KCl (Table 1).

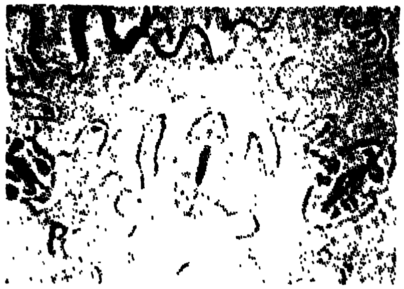

Fig. 1. Stomatal aperture in BA + K treated epidermal peels, 120 min after transfer to mannitol

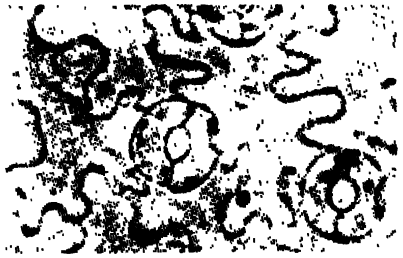

Fig. 2. Stomatal aperture in BA + K treated epidermal peels, 120 min after transfer to water

TABLE 1 : Effect of transferring fully opened stomata from BAK (BA 2 ppm + KCl 0.075 M) to water and mannitol (0.125 m)

Stomatal aperture size (mμ)

Time after transfer (min)	Water	Mannitol
0	6.6	6.6
30	5.2	2.1
60	3.0	1.5
120	2.5	0

Significant at 5%

Solutions (S)	0.6
Time intervals (t)	0.8
S × t	1.0

The stomatal closure induced by mannitol was not merely an osmotic effect. Epidermal peels pre-treated with isoosmotic solutions of PEG 6000 and mannitol (– 5 bars) were transferred to a medium containing 2 ppm BA and 75 mM KCl to induce stomatal opening. The closed stomata of epidermal peels pre-treated with PEG opened within 60 min on transfer to BA+K. However, the stomata of the epidermal

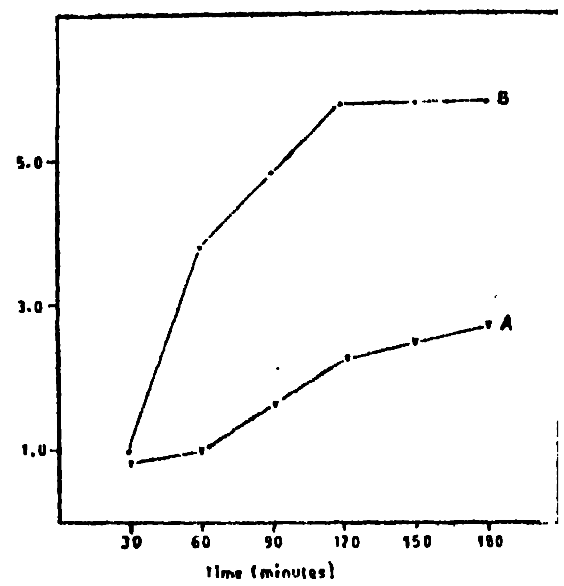

Fig. 3. Time course study of stomatal aperture opening in epidermal peels of *Impatiens balsamina* pretreated with iso-osmotic concentrations of mannitol and PEG (6000 mol wt) on transfer to benzyladenine + potassium chloride. (Mannitol, A ; PEG, B)

peels pre-treated with mannitol did not open even after 180 min.

This effect of mannitol on stomatal closure may have a role in conserving moisture under stress. It has been suggested[5] that there may be substances other than ABA which could be regulating stomatal closure under stress. Polyols could be one among such substances.

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Steroidal sapogenins in two wild species of *Solanum*

In pharmaceutical industry, different steroidal sapogenins act as the basic precursor material for preparing pharmacologically active steroids. Many plants under the Solanaceae are known to contain different steroidal sapogenins and alkaloids and many members of this family also grow extensively as weeds. In the present study, two such weed plants, *Solanum surratense* and *S. sisymbri folium*, growing near Calcutta in West Bengal were collected in the months of July-August and their roots, stems with leaves and berries (unripe and ripe) were examined for steroidal sapogenin content.

The plants bearing fruits were uprooted at random and their roots, stems and other organs were separated for analyses. The samples of each organ were dried (68°C—4 days) and the analyses were done at the Organon (India) Chemical Factory at Dum Dum, Calcutta. The dried samples were ground, sieved (40 mesh) and extracted with methanol in a Soxhlet apparatus. The extract-volumes were reduced to about 5 ml by warming (60°C) and hydrolyzed with equal volume of Conc. HCl. The hydrolyzates were made alkaline with NaOH solution so that solasodine and solasodiene are freed to insoluble bases. Water was added, filtered and residue is washed several times till neutral to litmus. Residue was dried (80°C), taken in chloroform and after discarding the chloroform fraction, the final residue was taken in 2 ml of acetone : methanol mixtures (1 : 1) for gas chromatography.

To make standard, 154.55 mg of pure Solasodine and 80.05 mg of Solasodiene were dissolved in 100 ml of methyliso-butyl ketone. 5 ml of this standard soln was diluted to 10 ml with the solvent. Chromatography was done in a Packard Gas Chromatograph apparatus, using column as O.V.—101 and length and internal diameter of the columns respectively as 155 cm and 4 mm. The detector used was Flame Ionisation Detector, pressure for hydrogen and nitro-

TABLE 1 : Solasodine, solasodiene and unidentified steroidal compound in two species of *Solanum*

Species	Steroidal sapogenins	Contents (mg/100 g dry tissues) in case of solasodine and solasodiene and peak heights in chrom. graphs (for extracts from 100 g dry tissues) in case of unidentified compound in			
		Root	Leaves & Stems	Berries	
				Unripe	Fully ripe
	solasodine	414	656	939	987
S. surratense	solasodiene	186	266	423	621
	Unidentified	40	13	7	5.
	solasodine	27	56	174	187
S. sisymbrifolium	solasodiene	13	12	50	66
	Unidentified	32	19	8	3

gen (carrier) gases as 55 ml and 50 ml per minute respectively, air as 600 ml per minute, detector temperature as 300°C and oven and injection port temperature as 275° and 280°C respectively. The volume injected for each test sample as well as for standard were 1 μl. After injection, the retention times of the main peaks of the samples were noted and compared with times for solasodine and solasodiene solutions to ascertain the presence of these two constitutents in the samples. The peak heights in graphs indicated the relative concentrations of the constituents.

As shown in Table 1, the solasodine content observed in the two *Solanum* sp. cannot be said to be appreciably high when compared to plants of other *Solanum* species[1-4]. Besides solasodine and another related sapogenin; solasodiene; the present extracts were also found to contain an unidentified steroidal compound, having retention time as 2 min after injection. It is interesting that the peak heights of this unidentified compound, indicating its relative contents were the highest in roots and were of decreasing order in leaves and stems and unripe and ripe berries in both the species and thus, showed some difference in the pattern of distribution of solasodine and solasodiene contents in the same tissues.

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Chemical detection of some organic compounds with specially prepared dye-reagents

In an earlier communication[1], it was reported that aqueous solutions of toluidine blue O, brilliant cresyl blue and Meldola's blue can be decolourised with sulphuric acid and sodium sulphide. The dye-reagents thus prepared can be used to produce colour reactions with a wide variety of organic compounds. The present investigation was undertaken in order to find out if basic fuchsin and cresyl fast violet, containing primary amino group in their molecules, can be decolourised with chemicals other than sulphuric acid and sodium sulphide and yet would remain useful for the chemical detection of some organic compounds.

Basic fuchsin (Merck); belonging to aminotriarylmethane group and cresyl fast violet (Fluka); belonging to oxazine group of dyes, were used in this investigation. Basic fuchsin dye-reagent was prepared by dissolving 100 mg of the dye in 100 ml of warm distilled water. To this were added

TABLE 1 : Reaction of Organic Compounds with two reagents

Compound	Basic fuchsin	Cresyl fast violet
I. *Alcohols*		
(a) Methanol	+ve (violet)	+ve (blue
(b) Ethanol	+ve (,,)	+ve (,
(c) n-Propanol	+ve (,,)	+ve (,,)
(d) iso-Propanol	+ve (magenta)	+ve (,,)
(e) n-Butanol	+ve (upper violet ; lower colourless)	+ve (,,)
(f) iso-Butanol	+ve (,,)	+ve (,,)
(g) tert-Butanol	+ve (violet)	+ve (,,)
(h) n-Pentanol	+ve (upper violet ; lower colourless)	+ve (upper blue ; lower colourless)
II. *Ketones*		
(a) Acetone	+ve (violet)	+ve (blue)
(b) Methyl ethyl ketone	+ve (,,)	+ve (sky-blue)
(c) Cyclohexanone	+ve (upper violet ; lower pale violet with violet ppt.)	—ve
(d) Acetophenone	+ve (upper violet ; lower colourless)	+ve (upper navy blue ; lower colourless)
III. *Aldehydes*		
(a) Formaldehyde	+ve (violet)	+ve (blue)
(b) Acetaldehyde	+ve (pale violet)	+ve (,,)
(c) Glutaraldehyde	+ve (sky-blue)	+ve (,,)
(d) Paraldehyde	+ve (upper violet ; lower sky-blue)	+ve (,,)
(e) Benzaldehyde	+ve (upper blue ; lower pale yellow)	+ve (,,)
(f) Salicylaldehyde	+ve (upper colourless ; lower violet)	+ve (upper scarlet ; lower pale red)
(g) Anisaldehyde	+ve (upper colourless ; lower blue)	+ve (upper scarlet ; lower colourless)
(h) Cinnamaldehyde	+ve (upper turbid, colourless ; lower brown ppt.)	+ve (upper original ; lower pale pink)
IV. *Carboxylic acids*		
(a) Formic acid	+ve (steel gray)	—ve
(b) Acetic acid	+ve (sky-blue)	+ve (pale blue)
(c) Linoleic acid	+ve (cloudy, colourless)	—ve
(d) Oleic acid	+ve (,,)	—ve
V. *Ethers*		
(a) Solvent ether	+ve (pink)	+ve (bluish-violet)
(b) Anisole	+ve (upper pink ; lower colourless)	+ve (upper violet ; lower yellow)
(c) Phenetole	+ve (upper pale pink ; lower original)	—ve
(d) Dioxane	+ve (pale pink)	+ve (upper violet ; lower yellow)
(e) Tetrahydrofuran	+ve (violet)	+ve (greenish-blue)
VI. *Amines*		
(a) Mono ethyl amine	+ve (magenta)	—ve
(b) Tributylamine	+ve (upper colourless ; lower pink)	+ve (upper pale green ; middle violet ; lower colourless)
(c) Dimethylaniline	+ve (upper scarlet ; lower pink)	+ve (upper sky-blue ; lower blue)
(d) Pyridine	+ve (magenta)	+ve (blue)

10 ml or 10 g of sodium perchlorate ($NaCLO_4.H_2O$) and 1 ml of conc. sulphuric acid. These were mixed thoroughly. Apparently perchloric acid was produced by this mixture, since perchloric acid could alone decolourise this dye solution. The semi-decolourised dye-reagent was then shaken vigorously with 1.0 g of activated charcoal and filtered. The filtrate appeared to be pale orange in colour when viewed in a glass container. In test tube; it appeared to be pale straw in colour. This reagent registered pH 0.9. Cresyl fast violet dye-reagent was prepared by dissolving 20 mg of the dye in 100 ml of warm distilled water. To this was added 100 ml of perchloric acid and mixed thoroughly. The dye-reagent appeared to be brown in colour when seen in a glass container, but in the test tube it appeared to be pale yellow. The pH of this reagent was 0.5.

The list of organic compounds tested to give positive or negative colour reactions is presented in Table 1. It is evident that all the alcohols, ketones; aldehydes, carboxylic acids; amines and ethers tested in this investigation gave positive colour reaction with basic fuchsin dye-reagent. In the case of cresyl fast violet reagent, only all the alcohols and aldehydes gave positive reaction. Carboxylic acids, such as formic; linoleic and oleic gave negative reaction with this reagent. Among ketones tested, all but cyclohexanone gave positive colour reaction. Phenetole, an ether, also gave negative result with cresyl fast violet dye-reagent.

Both these dye-reagents do not exhibit regeneration of colours characteristics of the dyes when exposed to shortwave UV rays[2,3] and these are also not useful in producing aldehyde reaction in Feulgen procedure. Therefore, these dye-reagents are not similar to Schiff reagent.

With 0.1 N NaOH, basic fuchsin dye-reagent gave an intense magenta colour and cresyl fast violet dye-reagent, a blue colouration. With tap and distilled water; both the dye-reagents produced pale pink colouration. Cresyl fast violet gave a pale blue colouration with a mild hydrochloric acid; while with this acid; positive result was not achieved with basic fuchsin dye-reagent. Addition of solvent ether (pH 4.5 to 5.0) to basic fuchsin dye-reagent and to cresyl fast violet dye-reagent produced an uniform pink colouration in the former case and an uniform bluish-violet colour in the latter. Chloroform reacted with both the dye-reagents producing pale red colour with basic fuchsin reagent and an extremely pale pink colouration with the other dye-reagent.

From these observations, it is reasonable to conclude that a chemical reaction takes place between the reactive groups of these dye-reagents and those of the organic compounds. Formation of two-layered coloured solutions; as found in some of the compound-reagent mixtures, in the case of both the dye-reagents supports this interpretation.

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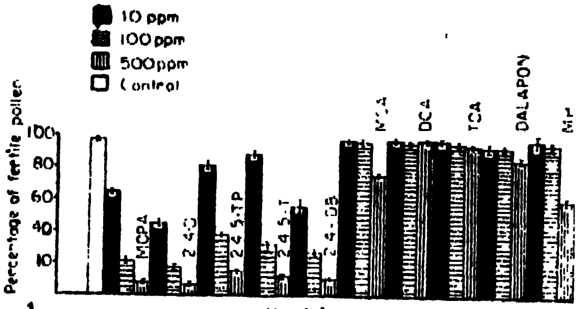
Effect of certain herbicides on the pollen of *Abutilon indicum* (L.) Sw.

The study of herbicidal action on reproductive organs of plants has received comparatively less attention. This is not surprising in view of the fact that the eradication of weeds is emphasised either at pre-emergence[1] or at an early and active stage of growth prior to flowering[2,3]. Reproductive structures and yield remain unaffected if the herbicides are applied at an early growth phase[4-6]. Pollen investigation is necessary in order to assess the inhibiting effects of herbicides on the reproductive behaviour of plants. Because of unique ecophysiological responses of weed seeds and weed seedlings against herbicides, a common weed of the Malvaceae—***Abutilon indicum*** (L.) Sw.—was selected for the purpose.

From 95-day old *A. indicum* plants (raised in a series of pots at the Experimental Garden of the Botany Department, University of Calcutta), 5 plants were selected per pot and were aerially sprayed by means of hand-held pressurised sprayer with three concentrations (10, 100 and 500 ppm—each adjusted to pH 7.0) of the aqueous solution (100 ml) of MCPA (4-Chloro-2 methylphenoxyacetic acid); 2, 4-D (2, 4-Dichlorophenoxyacetic acid); 2, 4, 5-TP [2-(2, 4, 5-Trichlorophenoxypropionic acid]; 2, 4, 5-T (2, 4, 5-Trichlorophenoxyacetic acid); 2, 4-DB (4-[2, 4-Dichlorophenoxyacetic]-butyric acid); MCA, DCA and TCA (Mono-, Di- & Trichloroacetic acids); Dalapon (2, 2-Dichloropropionic acid) and MH (1, 2-Dihydro-3, 6-pyridazine-dione) to the dripping point. Adequate controls and four replications were maintained per treatment. All herbicides were not of commercial formulations and were 99.9% pure. A week after treatment, pollen-grains from mature anthers were dusted on grease-free clean slides. To study pollen fertility, methods proposed by Sharma and Sharma[7] and followed by Ladizinsky[8] were adopted. Five hundred pollen-grains were scored for both treated and untreated plants and were considered normal if they were spherical and had darkly-stained cytoplasm.

In general, plants treated with phenoxy compounds led to epinasty, chlorosis, wilting and temporary suspension of growth. These herbicides alongside maximum concentration of MCA, Dalapon and MH reduced pollen fertility (Fig. 1). The pollen-grains presumed to be sterile were deformed and had little stained or unstained cytoplasm characterised by emptiness, vacuolisation and plasma coagulation (Fig. 2). In this process, 2, 4-D was the most aggressive; this was followed by MCPA and 2, 4-DB. While these three herbicides were active at all concentrations, 2, 4, 5-TP and 2, 4, 5-T were less harmful.



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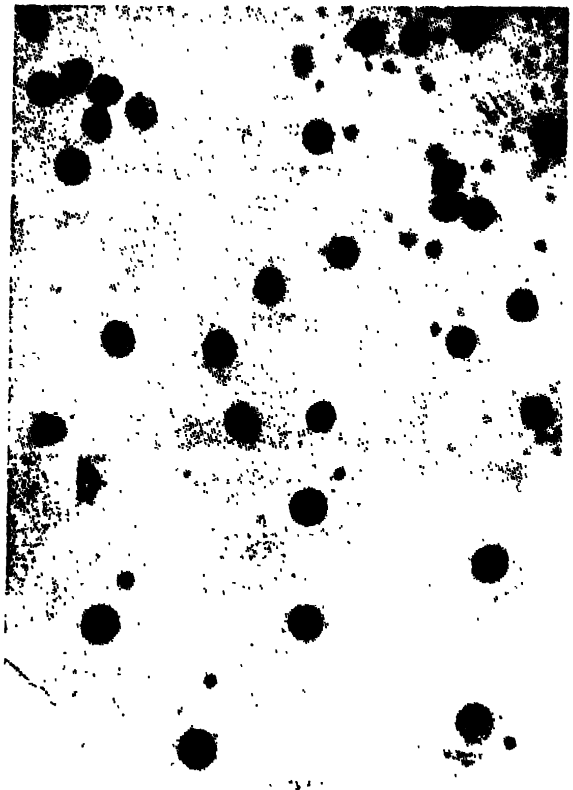

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Figs. 1-2. Pollen fertility of *A. indicum*: (1) Fertility percentage of pollen-grains as affected by herbicidal spray during anthesis. (2) Upper left: sterile pollen from 2,4-D treated plants; upper right: sterile pollen from MH treated plants; lower centre: fertile pollen from normal untreated plants. (All ×250).

Among non-phenoxys, the activity seemed to be high for MH and MCA and low for Dalapon, all at 500 ppm. All concentrations of DCA and TCA were virtually ineffective.

Differences in the magnitude of herbicidal action can be attributed to their chemical configuration. All potent herbicides probably have an influence when applied at microsporogenesis on the behaviour and cellular activities of microspores. Pollen sterility has been registered in crop plants like maize[5], brinjal[9] and pea[8] with the use of MH, 2, 4-D and 2, 4, 5-T respectively, but there is no report on any tropical weeds so far. All phenoxys, together with MCA, Dalapon and MH can render pollen-grains sterile and can be applied promisingly against noxious weeds.

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Electron microscopy of the virus causing leaf mosaic of jute in leaf-exudate

Leaf mosaic of jute is a very serious disease, occurring in many jute-growing countries like India and Bangladesh[1]. A recent report from Bangladesh showed about 59.3-100% incidence of leaf mosaic of jute resulting in 18-46% fibre losses[2]. The disease is caused by a virus and is transmitted through seed, grafting and whitefly vector *Bemisia tabaci*[3-7]. Although some work have been done with regard to host range, transmission and symptomatology, repeated efforts to identify and characterise the causal virus have so far not been successful. The present investigation was undertaken to identify and characterise the causal virus under electron microscope.

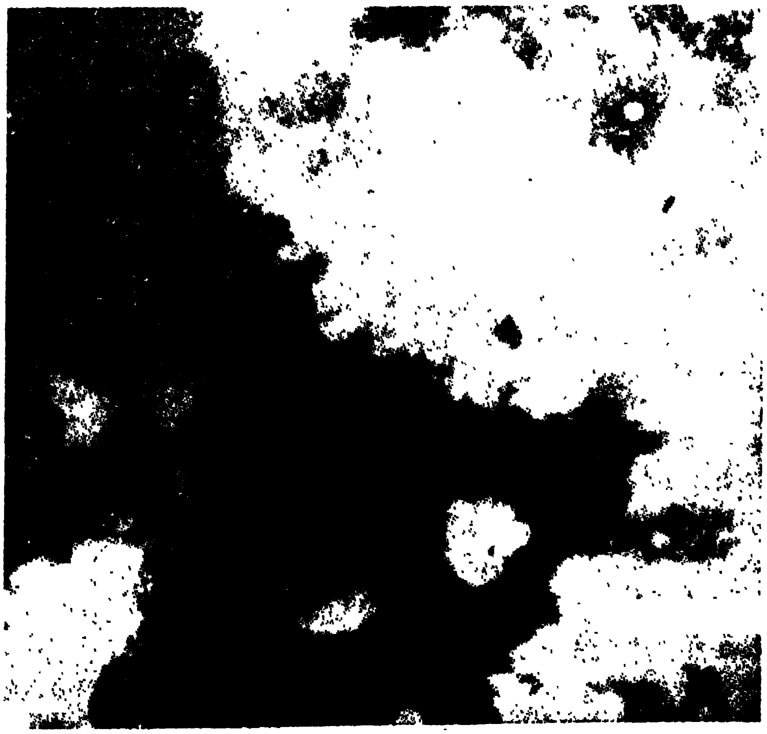

Fig. 1. Electron micrograph of negatively stained leaf exudate preparations from jute plant infected with leaf mosaic virus showing spherical virus particle (× 86750).

Seeds from both healthy and leaf-mosaic infected jute plants (*Corchorus cupsularis* L. cv. D 154) were collected. They were sown in 15-cm clay pots containing clay loam soil. About three weeks after emergence, the seedlings of the infected seeds showed typical leaf-mosaic symptoms, while those from healthy seeds remained green. Leaves showing typical symptoms of leaf mosaic and corresponding leaves from healthy plants were harvested, washed and thoroughly dried. The presence of virus in these leaves was electron microscopically examined following modified leaf-dip method[8]. A few drops of double-distilled water were taken on a thoroughly clean and grease-free glass slide. Sharply cut and exposed end of a leaf was dipped in it with slight pressure so that part of the content of the ruptured cells flowed into the water drops. The dipping was repeated thrice. Then formvar-coated grids were floated on the drops with the coated surface facing down. The grids were taken out, excess water removed and dried. The grids were then negatively stained with 2% potassium salt of phosphotungstic acid at pH 6.8 for 6 min. The grids were then rapidly dried and examined under electron microscope (Model Philips EM—300) at 27500 magnification.

Virus particles were observed in preparations from diseased leaves, while no such particle was observed in those from healthy leaves. Although the particles were fewer in number, they were characteristic in shape and size (Fig. 1). The particles were spherical in shape and measured about 23 nm in diameter. The present study, therefore, confirmed the viral nature of the disease and characterized the virus particle.

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Relative activities of nitrogenase and nitrate reductase in mungbean and clusterbean under dry land condition

Available evidences[1-3] indicate that in certain legumes like soybean, NO_3^- reduction is more important at the pre-flowering stage whereas the nitrogenase activity (N_2-ase) gains prominence after the leaf nitrate reductase activity (leaf-NRA) declines. The situation is reported[4] to be reverse in *Phaseolus vulgaris*, but the results generally support the succession of one mode of nitrogen utilization after the decline of the other. In *Medicago sativa*, increase of nodular-NRA under water stress has been shown[5] to be associated with declines in N_2-ase and leaf-NRA. Thus, it seems that only one of the above three mechanisms principally contributes nitrogen to plants at a time when the others are less effective for one reason or another. In order to test this conjecture, N_2-ase, leaf-NRA (representative leaf disks) and nodular-NRA of clusterbean (*Cyamopsis tetragonoloba* var. FS-277) and mungbean (*Vigna radiata* var. S-8) were studied under field conditions during 7th to 56th (pod formation) days from sowing (July 22, 1982) on loamy sand soil (0.15% organic carbon, 12 kg ha^{-1} available phosphorus as P_2O_5 and 220 kg ha^{-1} available potassium as K_2O) at the Central Research Farm of this Institute at Jodhpur (av. rainfall 360 mm).

The availability of water to plants was generally low due to poor rainfall (173.5 mm) during the experimental period and stress was acute around the 19th day and also beyond the 35th day after sowing (Fig. 1A). Under these conditions, N_2-ase activity of both the legumes progressively increased up to about the 28th day prior to the onset of flowering and declined thereafter (Fig. 1B). N_2 ase activity per unit of nodule weight of mungbean was markedly more than that of clusterbean, whereas the leaf-NRA of clusterbean remained markedly higher than mungbean (Fig. 1C). In both mungbean and clusterbean, peaks of activity were attained around the 20th and the 28th day respectively before the inception of flowering. Thus, NO_3^- reduction and N_2-ase activity in these legumes appear to be parallel, rather than successive events at different developmental stages.

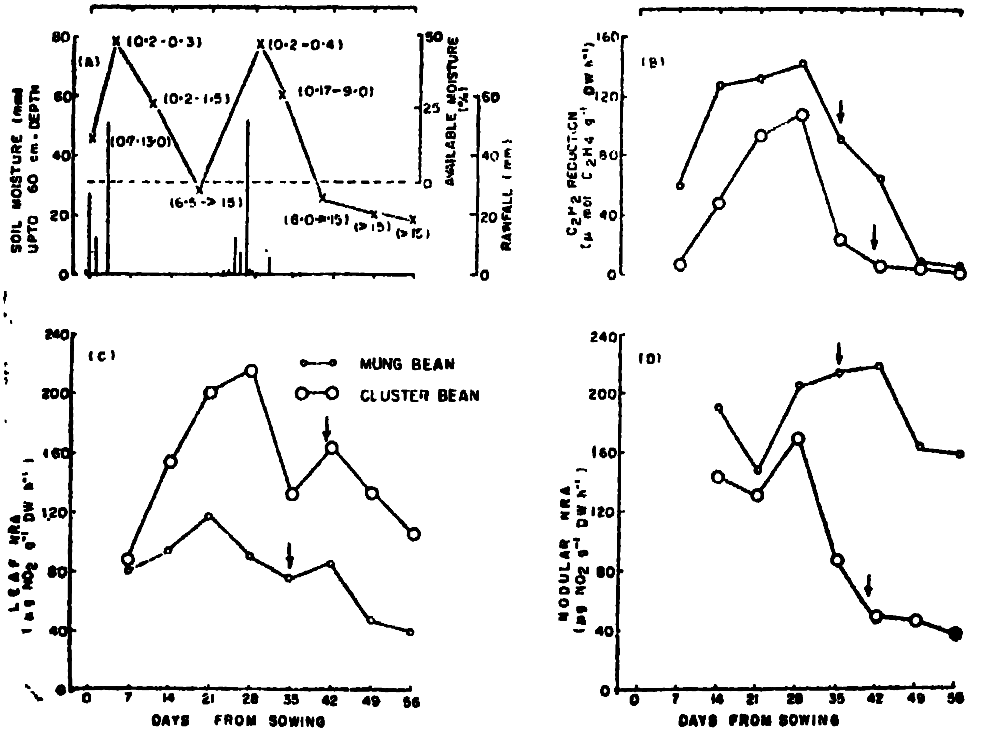

Fig. 1. A, Average soil moisture during the experimental period (X·········X soil moisture) where values within brackets indicate the range of ψ soil in bars and vertical lines represent rainfall. B, C and D indicate N_2-ase activity, leaf-NRA and nodular-NRA respectively; ↓ indicates the time of flowering.

In contrast to the situation found in leaf-NRA, the nodular-NRA was generally higher in mungbean as compared to clusterbean (Fig. 1D). In the case of mungbean, the contention of stress-mediated increase of nodular-NRA with associated declines in N_2-ase and leaf-NRA may be broadly acceptable. This may not however, hold true in case of clusterbean, where the nodular-NRA progressively declined beyond the 28th day of sowing. Results further indicate that N_2-ase, leaf-NRA and nodular-NRA operate simultaneously rather than one at a time.

This study suggests that the interplay of processes involved in biological N_2-fixation and NO_3^- assimilation may vary widely in different legumes and a generalisation in this area seems rather difficult.

NO_3^- reduction and N_2-ase activity seem to be parallel rather than successive processes. But mungbean and clusterbean, under field drought, showed wide divergence in N_2-ase, leaf- and nodular-NRA activities.

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Responses of *Abutilon indicum* to phenoxy herbicides

While pre-sowing treatment with herbicides may allow the establishment of weed seedlings before proving lethal, it is important to decide upon an appropriate herbicide and a lethal range to tackle a pernicious weed. The present communication is aimed at finding out the ecophysiological responses to certain phenoxy herbicides of seeds and seedlings of *Abutilon indicum* (L.) Sw., a hairy perennial undershrub with golden yellow, which is abundant in the hotter parts of India and is a common weed along roadsides and in high cultivated lands.

Acid-scarified (conc. H_2SO_4 for 2 hr) seeds of *A. indicum* were washed thoroughly in distilled water and soaked in herbicidal solutions for 24 hr at room temperature (28 ±3°C). The herbicides were MCPA (4-chloro-2 methylphenoxyacetic acid), 2, 4-D (2, 4-dichlorophenoxyacetic acid), 2, 4, 5-T (2, 4, 5-trichlorophenoxyacetic acid), 2, 4, 5-TP [2-(2, 4, 5-trichlorophenoxy) propionic acid] and 2, 4-DB [4-(2, 4-dichlorophenoxy)-butyric acid]. Aqueous solutions of these compounds were made to give 0.01 to 500 ppm (mg/litre) of the active ingredient ; the pH of these solutions were adjusted to 7.0. Following the pre-soaking, the seeds were washed again in water and then sown in plots of 50 × 50 sq cm. There were four replications per treatment. The plots were watered regularly and kept under observation for 45 days in order to record germination values, seedling survival and other pertinent data.

A somewhat uniform stimulatory action at 0.01-1.0 ppm was registered by MCPA and 2, 4, 5-T, whereas such action came only from 0.01-0.1 ppm 2, 4-D (Table 1). Although 10 ppm 2, 4, 5-TP greatly improved seed germination, other phenoxys at the same concentration were either inhibitory e.g.,

TABLE 1 : Germination and seedling survival of *A. indicum* as affected by pre-sowing treatment with phenoxy herbicides

Concentration of herbicides (ppm)	Delay in germination from the control (days)	Germination as percentage of control	Seedling survival as percentage of control
MCPA 0.01	0	138.8	90 9
0.1	0	116.3	100.9
1.0	0	116.3	99.0
10	1	91.8	82.8
100	11	46.9	69.5
500	16	10.2	0
2, 4-D 0.01	0	137.0	108.6
0.1	1	132.6	106.3
1.0	1	97.8	83.9
10	6	50.0	51.3
100	11	23.9	47.2
500	0	0	0
2, 4, 5-T			
0.01	0	135 3	98.4
0.1	0	133.3	103.2
1.0	0	125.5	104.3
10	0	102.0	103.6
100	9	60.8	106.2
500	9	19.6	86.3
2, 4, 5-TP			
0.01	0	151.3	96.8
0.1	0	159.0	101.3
1.0	0	166.7	00.0
10	0	174.4	98.8
100	8	102.6	88.8
500	10	28.2	83.9
2, 4-DB 0.01	1	89.5	102.5
0.1	0	88.1	98.7
1.0	1	49.2	96.5
10	5	26.9	54.9
100	13	11.9	13.7
500	13	3.0	0

2, 4-D and 2, 4-DB or of no effect, e.g. MCPA and 2, 4, 5-T. A delay in germination was encountered, being marked with increasing concentration from 10 ppm onwards for two herbicides (2, 4-D and 2, 4-DB) and 100 ppm for three herbicides (MCPA, 2, 4, 5-T and 2, 4, 5-TP). Abnormal germination was common at higher concentrations (100-500 ppm) for all phenoxys. Seedlings, arising from such pre-treatments, had their radicles protruding upwards and cotyledons buried in the soil—a case of negative geotropism.

Seedlings derived from 500 ppm MCPA, 2, 4-D and 2, 4-DB did not survive at all. But this was not the case with other herbicides of the same concentration. While 0.1-1.0 ppm 2, 4-D encouraged the vigorous growth of seedlings, stunted growth was noted in higher concentrations of MCPA, 2, 4, 5-T and 2, 4, 5-TP. With the use of 10-100 ppm 2, 4-D and 1-10 ppm 2, 4-DB, emerging seedlings were characterised by connation and malformation of leaves as well as irregular swellings on the stem. Furthermore, toxic effects of phenoxy compounds were evident in tumour-like outgrowth at the root-stem transition zone, rudimentary root system, loss of geotropism by root, etc. All these symptoms preceded mortality.

Stimulatory action of auxins on seed germination is relatively less known[1-5]. This is also established with *A. indicum* upon pre-sowing treatment with 2, 4-D and related compounds. Possibly the external application of phenoxy herbicides at optimum dosage accelerated the accumulation and translocation of native auxins to such an extent as to either break dormancy or lead the process to perfection.

Formative effect of 2, 4-D and 2, 4-DB on the developing/differentiating leaves of 30-day-old *A. indicum* plants was reported earlier[6]. This effect on seedling is possibly a consequence of the disturbance of correlation as indicated by Wu and Kozlowski[7] by treating seeds of *Pinus resinosa* with 2, 4, 5-T.

Geotropic responses are the ultimate manifestations of the actions and interactions among endogenous auxins. Phenoxy compounds are thought to disturb these normal actions[8-9]. Although anti-tropistic activity is generally correlated with auxin activity[8,10], all phenoxys used in the above study are strong auxins.

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Growth and yield of *Ammi majus* under different plant and row spacings

Ammi majus L., commonly known as honey plant, belongs to the family Umbellifereae. Its seed constitute principal commercial source of xanthotoxin, which is used in the treatment of leucoderma and also in formulating suntan lotions. In view of changing economic conditions, the farmers have started thinking to introduce some alternative crops which may prove more remunerative than they grow presently. Shifting some of the area to other suitable crops would not only ensure better returns but also help in diversifying the existing cropping pattern. Preliminary studies have shown that this crop can be raised successfully during winter in the Punjab. But for obtaining maximum yield suitable agronomic practices need to be worked out and proper plant spacings is one of the most important factors. The information on spacing in the literature is contradictory. Abrol[1] at Jammu suggested that 60 x 15 cm spacings is optimum for *Ammi* to get good yield. Singh[2] at Chakarta and Bradu and Atal[3] at Jammu suggested as the optimum spacings of 45 x 30 and 90 x 60 cm respectively for *Ammi majus*. The present study was conducted to work out the optimum plant and row spacing (plant population) for this crop under Punjab conditions.

The field experiments on *Ammi majus* to study the effects of plant and row spacings (Plant populations) on seed yield were conducted at Punjab Agricultural University during 1979-80 and 1980-81. The soil was loamy sand, testing low in organic carbon (0.15%) medium in P (15 kg/ha) and K (150 kg/ha). It was normal with respect to pH (8.2) and electrical conductivity (0.20 mmhos/cm) values. The treatments consisted of twelve combinations of three plant to plant (30, 45, 60 cm) and four row-to-row spacings (45, 60, 75, 90 cm). The different plant populations under various treatments were 74.0 (30 x 45), 55.5 (30 x 60), 44.4 (30 x 75), 37.0 (30 x 90) ; 49.4 (45 x 45), 37.0 (45 x 60), 29.6 (45 x 75), 24.7 (45 x 90) ; 37.0 (60 x 45), 27.8 (60 x 60), 22.2 (60 x 75), 18.5 (60 x 90) thousands per hectare. The experiment was laid out in randomized block design with four replications, having a plot size of 2.5 m x 8.0 m. The 55-day old seedling were transplanted on 30 November during 1979 and 16 December during 1980.

Since maturity of the crop is not uniform, the harvesting was done in the first week of May when the colour of 70% of the umbels turned brown and stems turned from green to pale-yellow to avoid shattering of the seeds. The first irrigation was applied immediately after transplanting. Timely irrigations were applied throughout the growth period of the crop. The crop received 75 kg N and 50 kg P_2O_5/ha during the years. One-third of nitrogen and whole phosphorus was drilled at transplanting and remaining nitrogen was applied in two splits 45 and 90 days after transplanting.

During both the years (Table 1), the higher seed yield was recorded with higher plant population per hectare especially where

TABLE 1 : Effect of different plant populations on the growth and yield of *Ammi majus*

Plant Population/ha ('000)	Seed yield (q/ha)		Plant height (cm)		No. of branches per plant		No. of umbels per plant		Weight of grain per 50 c. c.	
	1979-80	1980-81	1979-80	1980-81	1979-80	1980-81	1979-80	1980-81	1979-80	1980-81
74.0 (30 x 45)	10.8	12.9	158.7	148.0	129.9	159.9	62.1	125.8	22.2	26.2
55.5 (30 x 60)	10.7	15.8	159.6	141.8	113.6	107.0	78.3	95.6	20.9	25.4
49.4 (45 x 45)	10.2	12.0	156.0	146.8	114.2	129.0	67.5	118.0	21.2	25.8
44.4 (30 x 75)	10.1	13.8	160.8	148.2	132.2	109.7	85.6	99.4	20.5	26.4
37.0 (30 x 90)	10.2	13.8	161.9	114.0	129.6	118.5	82.0	109.1	21.6	27.0
37.0 (45 x 60)	9.7	11.8	156.9	145.0	89.3	132.2	65.2	124.1	20.1	27.5
37.0 (60 x 45)	9.0	12.4	156.1	151.3	119.0	118.5	73.2	108.2	21.0	27.7
29.6 (45 x 75)	9.2	12.8	156.2	145.7	123.5	116.7	77.4	98.7	21.8	28.0
27.8 (60 x 60)	10.5	11.3	150.2	145.9	101.0	132.9	66.3	117.9	21.4	27.6
24.7 (45 x 90)	10.0	11.2	162.5	145.1	134.5	129.5	81.5	107.4	21.6	26.8
22.2 (60 x 75)	9.9	13.8	160.8	141.4	99.7	118.0	72.0	107.8	20.2	26.1
18.5 (60 x 90)	9.4	12.8	155.2	147.9	110.7	146.5	68.7	130.5	20.4	27.4
S. Em.	0.2	0.1	6.3	5.6	16.3	17.5	13.5	14.3	1.0	1.1
C. D. 5%	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.

he plants were spaced closer within the rows, i.e. 30 cm. The maximum seed yields were obtained with 74.0 and 55.5 thousand plant populations per hectare during both the years. However, these differences were not statistically significant. The growth and yield contributing characters like plant height, number of branches and umbels per plant and seed weight were also not affected significantly during both the years.

Keeping in view the plant canopy and other cultural practices, it may not be convenient to follow closer row spacing than 45 cm. So there is a need to try still closer spacing, especially between the plants. It may be concluded that to get high seed yield, *Ammi majus* may be planted in lines keeping plant-to-plant distance of 30 cm and a row-to-row distance of 45 cm (74.0 thousand plant population per hectare).

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Effect of interstock, rootstock and self-rooted cuttings on sex-ratio in sweet lime

Sweet lime (*Citrus limettioides* Tanaka) is known for its fruits having a therapeutic value. Its fruits ripen the earliest among all *Citrus* species and thus command the market during August-September. The cultivation of sweet lime has, however, been restricted due to its shy-bearing habit which is due to large proportion of staminate flowers[1-3]. The sweet lime trees, particularly raised from hard-wood cuttings assume a shy-bearing habit after yielding a couple of good crops[1,4]. When Jatti Khatti is used as rootstock, the plants assume vigorous vegetative growth and needs severe periodic pruning. More vegetative growth also leads to the diversion of assimilates thereby affecting flowering. Rubidoux, when used as rootstock or interstock, exhibits dwarfing effects on scion. Therefore, a trial was laid out at Fruit Research Station, Bathinda in 1976 with three treatments: (i) sweet lime budded over Jatti Khatti; (ii) sweet lime budded over Jatti Khatti with Rabidoux as an interstock; and (iii) plants raised from self-rooted stem cuttings. Though the trees came into bearing two years earlier, the commercial blooming was recorded this year. Hence, it was considered desirable to see the effect of rootstock and interstock on sex-ratio, particularly the percentage of hermaphrodite flowers.

Male and hermaphrodite flowers were counted from all the sides of the trees and on each tree 100 flowers were observed for their sex. The experiment was replicated 8 times with one tree as a treatment unit. The angular transformation of data was done.

Plants budded over Jatti Khatti gave the highest percentage of hermaphrodite flowers (Table 1) which was highly significant over interstock and plants raised from cuttings. In plants on Rubidoux as interstock and sweet lime on its stem cuttings the percentage of hermaphrodite flowers was quite low, the lowest being in the plants raised from

TABLE 1: Effect of interstock, rootstock and self-rooted cuttings on percent hermaphrodite flowers

Treatment	Hermaphrodite flowers (%)
Rubidoux as interstock	18.27 (9.83)
Jatti Khatti as rootstock	24.64 (17.38)
Self-rooted cuttings	16.88 (8.43)
C. D. at 5%	4.59
C. D. at 1%	6.36

Figures in parentheses are retransformed values the stem cuttings although the differences were statistically insignificant.

This clearly indicates that sweet lime plants should be raised on Jatti Khatti rootstock and not by cuttings.

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On the life-history of *Euproctis lunata* W. and *E. subnotata* W. (Lepidoptera : Lymantriidae) infesting cashew in Orissa

Lymantriids or tussock moths are a destructive group of leaf-feeding insects and have a wide host range such as, castor, cotton, cashew, guava, pomegranate and coffee[1,2]. In Orissa, two species of lymantriids, viz. *Euproctis lunata* W. and *E. subnotata* W. regularly infest the cashew plantations particularly on post-monsoon flushes and cause heavy damage to the young trees. The life-history of these two species was studied on cashew plants in the insectary of the Entomology Department, O.U.A.T.

Egg : The gravid moths of *E. lunata* laid 280-327 eggs on the undersurface of tender leaves in 15-17 tubular egg strands, each containing an average of 19 eggs. Eggs were arranged in paired rows and were covered with a hairy matrix. On the other hand, females of *E. subnotata* laid 186-273 eggs on the lower leaf surface in 4-8 egg batches. These eggs were round, distinctly depressed at the pole, shinning, creamy-white when freshly laid and changing to greyish yellow before hatching. The incubation period of *E. lunata* and *E. subnotata* varied from 6-7 days and 6-9 days respectively.

Larva : Freshly-emerged larvae of both

TABLE 1 : Life Stages of *E. lunata* and *E. subnotata* (temp. 24.7°C and 67% R. H.)

Stages	Duration (days)*			
	E lunata		*E subnotata*	
	Mean ±	S. D.	Mean ±	S. D.
Egg :	6.45	0.[illegible]4	7.00	1.02
Larva (instars)				
I	3.35	0.62	5.35	0.41
II	3 35	0.24	4.50	0.47
III	3.15	0.24	4.20	0.42
IV	3.55	0.44	4.25	0.35
V	3.45	0.37	5 20	0.42
VI	3.80	0.35	5.10	0.31
Total	20.65	1.04	2[illegible].60	1.96
Pupa :	17 00	0 00	15.60	0.69
Adult longevity :				
Female :				
Pre-oviposition	1.25	0.42	2.50	0.47
Oviposition	2.75	0.42	2.25	0 42
Post-oviposition	3.75	0.66	2.10	0.21
Male :	4.40	0.66	4.[illegible]0	0.41
Total life cycle	51.95	2.31	58 00	4.10

* — Mean of 10 individuals

the species were pale orange and were sparsely clothed with poisonous hairs. There were 6 larval instars. Moulting took place in the evening hours. The larval stage occupied 19-22 days in *E. lunata* and 27-33 days in *E. subnotata* (Table 1). The early instar larvae were gregarious and fed on the leaf tissue. Later instars defoliated the plants completely.

Pupa : Pupation took place in thin silken cocoons in both *E lunata* and *E. subnotata* on the plant surface. Pupae were obtect and were slightly larger in the former species. Pupal stage lasted for 17 days and 14-16 days respectively in the above spp.

Adult : The adult moths emerged during the evening hours. The moths of *E. lunata* were weak fliers. The two sexes in *E. subnotata* were distinctly different with respect to their colour pattern. The male moths were dark grey with three yellowish specks at the anal margin of the fore wings; while the female moths were larger, robust and dark yellow in colour with three black spots on the anal margins of the fore wings. Mating took place during the day and the females were pro-ovigenic. The life-cycle of *E. lunata* was completed earlier than the *E. subnotata* (Table 1).

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Percentage of oxalic acid in leaves of different varieties of *Beta vulgaris* grown in sodic soils*

Beta vulgaris L., commonly known as sugar-beet, belongs to the Chenopodiaceae, commercially, 15-16% sugar is obtained from its roots, and the crop supplies about 45% of the world sugar[1]. In obtaining sugar, only roots are utilized while leaves are left as waste material. It is reported by Paul[2] that in the crown portion with leaves oxalic acid ranges from 1.72 to 3.10%. Commercial importance of oxalic acid in various industries like, textile, dye stripping, degumming and other industries is well-known[3].

Free oxalic acid levels in leaves of different varieties of sugar-beet, grown in sodic soils at Biomass Research Centre, Banthra during 1981-82 were determined. The seeds obtained from project coordinate sugar-beet, Pant Nagar Agriculture University, Naini Tal were utilized for raising the varieties.

Sugar-beet crop under Lucknow conditions mature during the month of March/April. Mature leaves of all the varieties were collected on a single day. These were oven-dried at 60-80°C for 24 h, powdered and packed in polythene bags.

The dried powder of each sample was taken in conical flasks to which 100 ml of distilled water was added. The flask with the leaf powder was placed over a water bath and heated for 8-10 h. The filtered solution was titrated against N/10 sodium hydroxide solution (Normality—0.199 N) and the readings so obtained were converted to percentage after multiplying with the oxalic-acid factor. The average percentage obtained of free oxalic acid is recorded in Table 1.

It is observed from Table 1 that out of the 18 varieties of sugar beet, maximum percentage of free acid was found in the varieties Desperensply Re (0.67%), Ramolave (0.63%), H-6120 (0.60%) and AJ-2 (0.58%). Medium percentage of acid was found in Polyrave-E (0.51%), Semarave (0.45%), Marinapoly (0.50%) and Tribel (0.53%). Lowest percentage of acid was found in Vitol-24 (0.13%), Trirave (0.26%) and Satorave (0.32%).

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TABLE 1 : Free oxalic acid percentage in leaves of different varieties of *Beta vulgaris* grown in sodic soils at Biomass Research Centre, Banthra, Lucknow

Variety	Acid (% dry wt.)
Vitol-24	0.13
Remolave	0.63
Desperensply-Re	0.67
Semarave	0.45
M. Marinapoly	0.52
AJ-1	0.57
Tribel	0.53
M. Autopoly	0.51
Satorave	0.32
M. Magnapoly	0.48
Polyrave-E	0.35
M. Extrapoly	0.43
Polyrave-N	0.58
Poly-X	0.43
H-6120	0.60
Ramonskaya-06	0.54
Trirave	0 26
AJ-2	0.58

The average yield of fresh leaves is 8.98 tons /ha. Usually the leaves have about 80% moisture content, thus on average availability of dry leaves will be nearly about 1.80 tons/ha. Thus, from a field of one hectare sugar-beet, 8-10 kg oxalic acid can be obtained (besides utilization of tubers for alcohol or sugar production). This could be an additional source of income to the farmers, thus here the waste material can be of industrial use.

Thanks are due to Dr. J. K. Maheshwari, Scientist-In-Charge, National Botanical Research Institute, Lucknow for providing necessary facilities.

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Studies with a new growth regulator (dikegulac-sodium) on some morphophysiological characters of *Raphanus sativus* L.

Dikegulac-sodium is a new physiologically active growth regulator with a broad spectrum of diverse effects on plant growth and development[1-6]. No report is yet available about its effects on seedling growth, root morphology, geotropic response, chlorophyll and carotenoids synthesis in *Raphanus sativus* L.—an important vegetable crop.

Seeds of *R. sativus* were germinated in sterilized Petri-dishes, lined with a double layer of filter paper, kept moist with either distilled water (control) or test solutions. Twenty seeds were placed in each dish and three replicates of each were repeated thrice. The experiments were run for 96 h under continuous light at temperature of 28±2°C. Acetone-soluble carotenoids and chlorophylls were estimated by determining the optical density of the extracts at 470 nm and 660 nm[7,8], respectively by the help of photoelectric colorimeter. Dry weight of radicle and hypocotyl was taken after drying them in an oven for 24 h at 80°C.

Dikegulac-sodium inhibited root growth and caused negative geotropic response (Table 1). The reduction of root length increased with increased concentrations. The growth of root hairs was severely inhibited beyond 100 mg/l concentration. The percent germination and hypocotyl growth were not significantly affected by the treatment. After 36 h of setting experiments, the radicles of seedlings treated with high concentrations became negatively geotropic. Dikegulac treatment retarded the formation of chlorophyll and carotenoids. The dry weight of radicle was reduced, whereas dry weight of hypocotyl increased in all the solutions tested except 500 mg/l.

Dikegulac-sodium works counter to gibberellins and auxins and in some respects it seem similar in action to morphactins[1]. In recent years, evidence have accumulated suggesting that roots are the site of gibberellin (GA) biosynthesis[9]. The inhibition of

TABLE 1 : Effect of dikegulac-sodium on 4-day old seedlings of *R. sativus*

Parameter	Concentration (mg/l) Control	100	200	300	500
Germination (%)	90.33 ± 3.0	89.66 ± 4.0	89.66 ± 3.5	90.66 ± 3.0	88.33 ± 2.0
Negative geotropism (%)	Nil	Nil	6.00 ± 0.0	9.00 ± 1.0	15.00 ± 1.0
Length of radicle (mm)	50.00 ± 5.0	35.18 ± 2.8	28.47 ± 3.4	22.77 ± 2.2	18.33 ± 2.0
Length of hypocotyl (mm)	32.06 ± 2.9	32.00 ± 2.7	30.00 ± 3.1	27.33 ± 2.1	27.00 ± 2.6
Dry weight radicle (mg)	0.66 ± 0.05	0.63 ± 0.04	0.56 ± 0.05	0.53 ± 0.04	0.43 ± 0.03
Dry weight hypocotyl (mg)	6.16 ± 0.32	8.26 ± 0.45	7.36 ± 0.42	7.00 ± 0.41	6.00 ± 0.49
Optical density (470 nm)	0.161 ± 0.022	0.155 ± 0.020	0.148 ± 0.014	0.145 ± 0.012	0.120 ± 0.012
Optical density (660 nm)	0.100 ± 0.014	0.098 ± 0.012	0.087 ± 0.008	0.082 ± 0.010	0.065 ± 0.005

growth of primary roots and root hairs with different concentrations of dikegulac-sodium is possibly related to its effects on GA biosynthesis. The action may cause reduction in GA as well as GA-induced DNA biosynthesis[1], necessary for root growth.

Geotropic growth curvature results from unequal growth rates along the upper and lower sides of the responding organs[8]. Dikegulac-sodium induced negative geotropism may be attributed to disruption of auxin transport or reduction of IAA and tryptophan level in roots[5,6]. These effects are similar to those of morphactins.

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Changes in activities of some oxidative and hydrolytic enzymes of orange (*Citrus reticulata* blanco) infected by *Alternaria alternata* (Fr.) Keissl

Profound changes in activities of several enzymes are known to take place in fruits during pathogenesis. Hydrolytic enzymes such as pectolytic, cellulolytic and proteolytic enzymes help pathogens to penetrate and invade host cells easily and effectively. Some oxidative enzymes, on the other hand, have been implicated in defence mechanisms of plants[1]. The present investigation was undertaken to study the changes in activities of some oxidative and hydrolytic enzymes of Nagpur mandarin oranges infected by a strain of *Alternaria alternata* (Fr.) Keissl, isolated in this laboratory[2].

Healthy fruits were surface-sterilized by washing in ethyl alcohol and were inoculated by injecting 0.2 ml (2×10^6 spores/ml) of *A. alternata.* Inoculated fruits were wrapped in sterilized polyethylene bags and incubated for 10 days at 26±2°C. Control fruits were also kept under identical conditions.

Enzyme activities in both rind and pulp portion of fruits were measured. Thirty percent extract was prepared in 0.1 M sodium phosphate buffer (pH —7.0.) Preliminary experiments indicated that addition of PVPP (Polyvinyl polypyrrolidinone, Sigma U.S.A.) in the extraction mixture had no effect on the recovery of enzyme activity and, therefore, it was not used in subsequent analyses. Homogenate was passed through a double layer of cheese cloth and clarified by centrifugation at 12,000 × g for 20 min. The supernatant was used as enzyme preparation. Peroxidase, catalase, ascorbic-acid oxidase and cytochrome-oxidase activities were measured following the methods of Maxwell and Bateman[3]. Amylase and invertase activities were measured by the method of Mattoo and Modi[4]. Reducing groups liberated from starch and sucrose were measured by the method of Nelson[5]. Protease activity was measured by the method of Ettan and Bateman[6]. Proteins in enzyme preparations were estimated by the method of Lowry *et al*[7].

The activities of enzymes studied were generally affected by *A. alternata* infection (Table 1). Peroxidase activity decreased in rind but remained unaltered in pulp. Catalase and ascorbic-acid oxidase activities increased in both the tissues. Cytochrome oxidase activity decreased in rind and was unaltered in pulp. Invertase activity, however, decreased with concomitant increase in amylase activity in both the tissues. Protease activity also increased in both the infected orange tissues.

TABLE 1 : Activities of oxidative and hydrolytic enzymes of orange fruits infected by *A alternata*

	Rind		Pulp	
	Healthy	Infected	Healthy	Infected
Peroxidase OD/min/mg protein at 485 nm	31.97±3.39	*22.60±4.79	71.68±5.29	*71.61±5.20
Catalase OD/min/mg protein at 240 nm	1.17±0.31	*2.03±0.75	4.59±0.11	*8 04±2.90
Ascorbic acid oxidase OD/min/mg protein at 260 nm	3.95±0.39	*4.59±0.28	19.86±3.21	*28.89±3.19
Cytochrome oxidase OD/min/mg protein at 550 nm	9.88±0.98	*7.76±0.76	37.00±3.70	*37.01±2.00
Amylase (mg reducing sugar liberated glucose/hr/mg protein)	9.30±4.40	**26.00±4.52	14.80±7.6	**61.00±4.48
Invertase (mg reducing sugar liberated glucose/hr/mg protein)	2.84±0.36	***1.15±0.37	4.86±0.4	***2.44±0.39
Protease (mg peptide fragment (B.S.A.) liberated/mg protein/hr.)	2.26±0.44	*4.52±0.50	7.40±0.46	*10.74±1 86

$^{*}P \angle 0.05$ $^{**}P \angle 0.02$ $^{***}P \angle 0.001$

Increased catalase activity has been reported by many workers in diseased plant tissues[2,8,9]. However, a decrease in catalase activity together with an increase in peroxidase activity in orange fruits have been reported by Chauhan *et al*[8]. Ascorbic-acid oxidase have been reported to increase during other fungal infections[10]. A change in cytochrome-oxidase activity in plant tissue during infection probably reflects impaired mitochondrial functions. In mango fruits infected by *Aspergillus flavus*, a decrease in both invertase and amylase activities have been reported by Mazumdar and Modi[11]. However, in infected apple fruits no change in amylase but a decrease in invertase activity was observed by Massand and Chhatpar[12]. A number of workers have reported an increase in protease activity during fungal pathogenesis[6,13]. It has been suggested that various amino acids released by protease action are immediately oxidized by fungal amino-acid oxidases resulting in dissappearance of released amino acids. Thus, both amino-acid oxidases and proteases appear to help the pathogen to attack the healthy tissue easily and effectively.

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Relative susceptibility of *Prunus* rootstocks to lime induced Fe-chlorosis

The availability of iron (Fe) to the plant is controlled rather sharply by the soil pH. In acid soils, appreciable amounts of iron are dissolved in the soil solution and available to the plant. However, in neutral or alkaline soils, iron is much more insoluble. In all the soils containing lime concentration >20%, the resulting increase in pH will cause symptoms of iron deficiency to appear in plants. Generally, the almond and peach × almond hybrid have been reported more tolerant to iron chlorosis as compared to the peach plants[1-5,6]. The information regarding the *Prunus* rootstock tolerant to iron chlorosis is lacking in India. Therefore, studies were conducted to determine the relative susceptibility of peach and almond rootstocks resistant to lime induced iron-chlorosis.

Five rootstocks, viz. Sloh (peach × almond hybrid), Sharbati, Sufeda, Noki and Chakli cultivars of peach with a population size of 500 each were transplanted in the nursery of Department of Horticulture, Punjab Agricultural University, Ludhiana during 1980-81. The soil was light textured, loam with pH 8.5, conductivity (mmhos/cm) >1.0, calcium carbonate >10% and lime concentration >20%. One-year-old seedlings were screened every year for the extent of chlorosis during August by visual observations and giving numerical values. The study was substantiated by estimating the total chlorophyll content in healthy and chlorotic seedlings[6].

The population of the seedlings with chlorotic leaves was very high in cvs of peach as compared with that of peach × almond hybrid seedlings (Table 1). During both the years, chlorotic seedlings (8.61 and 9.17%) were almost the same in peach × almond hybrid. These were significantly lower than those obtained in peach cultivars. Significantly, highest chlorotic population (54.79 and 41.25%) was obtained in Chakli rootstock. This was followed by cv Sufeda in susceptibility to iron chlorosis.

TABLE 1 : Peach and almond seedlings showing chlorosis and total chlorophyll content

Rootstock	Chlorotic seedlings (%)		Total chlorophyll (mg/g fresh wt. basis)			
			Healthy		Chlorotic	
	1980	1981	19 0	1981	1980	1981
Sloh (peach × almond hybrid)	8.61	9.17	1.42	1.64	0.46	0.50
Sharbati	27.10	24.09	1.39	1.43	0.39	0 41
Sufeda	33.40	35.32	1.31	1.34	0.31	0.26
Noki	23.75	26.28	1.40	1.57	0.25	0.30
Chakli	54.79	41.25	1.20	1.12	0.15	0.27
C.D. at :						
5% level	4.[illegible]73	3.643	NS	0.617	0.115	NS
1% level	7.369	5.625	NS	NS	NS	NS

During 1980, total chlorophyll content of healthy leaves did not differ significantly in the various rootstocks studied. However, during 1981 significantly highest total chlorophyll content (1.64 mg/g) was noted in Sloh seedlings as compared with that produced in leaves of peach rootstocks. It is also evident that chlorophyll content in the chlorotic leaves to the tune of 0.46 and 0.51 mg/g was produced during 1980 and 1981 respectively. In the chlorotic leaves of peach cvs chlorophyll content was lower than that noted in peach × almond hybrid leaves. Among the peach lines, significantly lowest chlorophyll content (0.15 mg/g) was produced in the chlorotic leaves borne on Chakli seedlings.

The present findings are in concurrence with those reported by Bernhard[1], Rallo[5] and Grasselly[2] who reported that peach × almond hybrids G.F. 677 and G.F. 557 were more resistant to chlorosis than peach seedlings G.F. 305 and S 2489 on calcareous soils. Earlier, Kester and Hansen[3] and Khajuria *et al.*[4] reported that almond and peach × almond hybrid seedling were tolerant to chlorosis but the peach seedlings were not resistant.

Sloh (peach × almond hybrid), Noki, Sharbati, Sufeda and Chakli rootstock were found to be decreasingly tolerant to lime-induced iron chlorosis. Fe-chlorosis is a grave problem in the peach plantation on high pH soils. Therefore, the use of Sloh (peach × almond hybrid) rootstock will amelioerate this problem.

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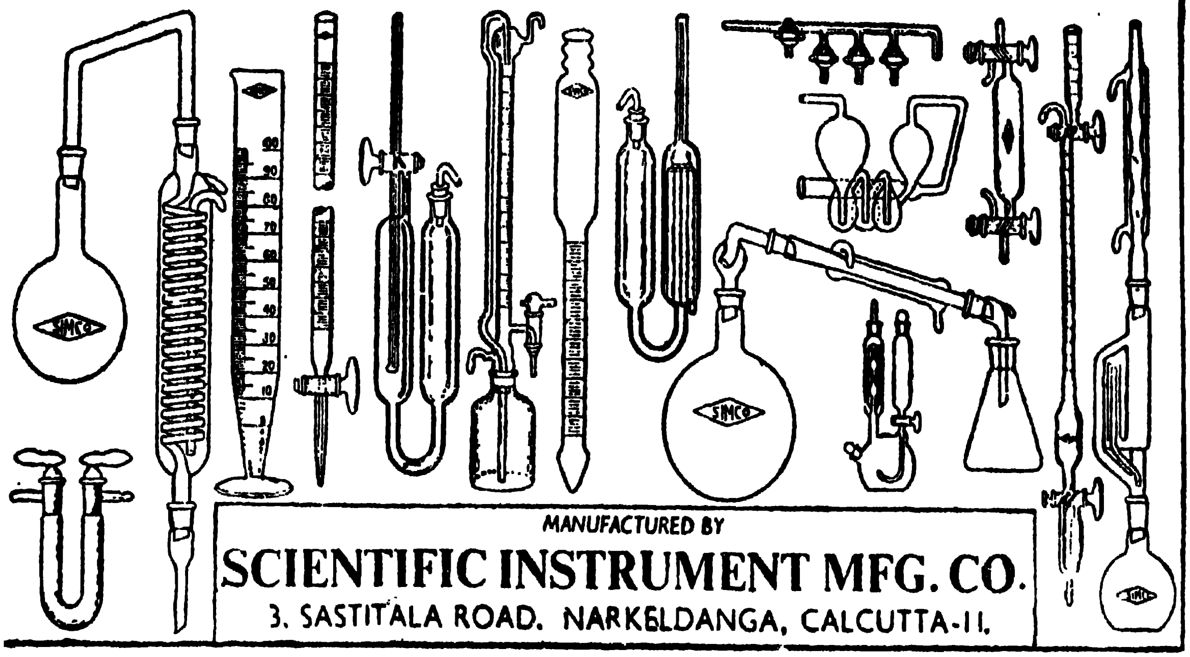

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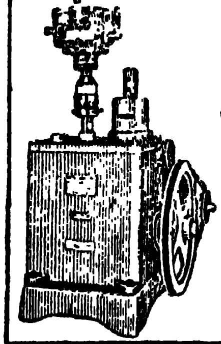

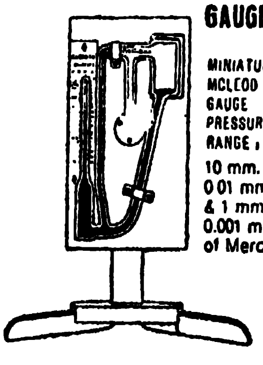

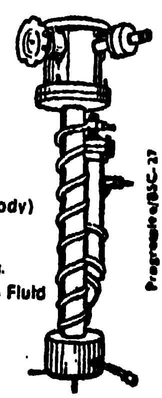

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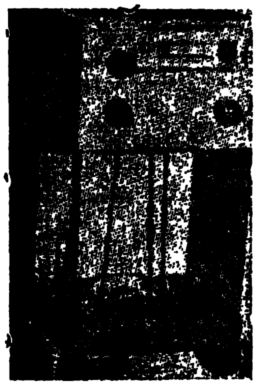

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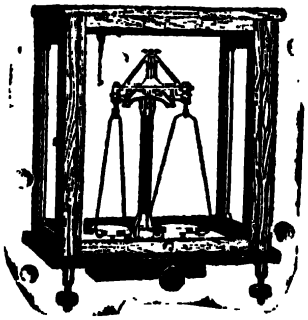

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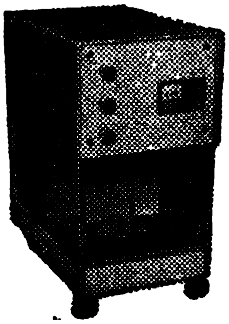

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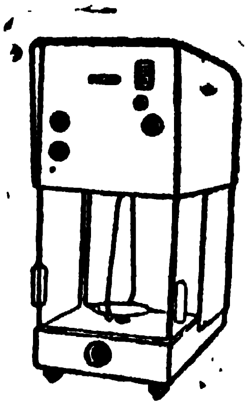

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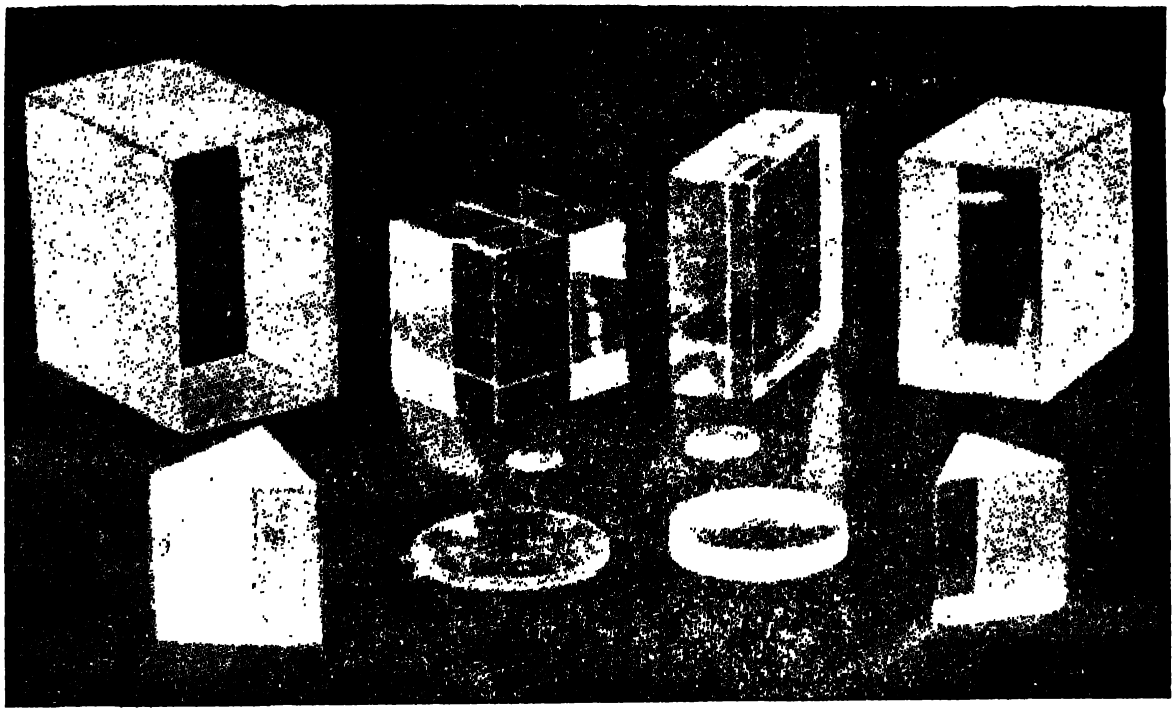

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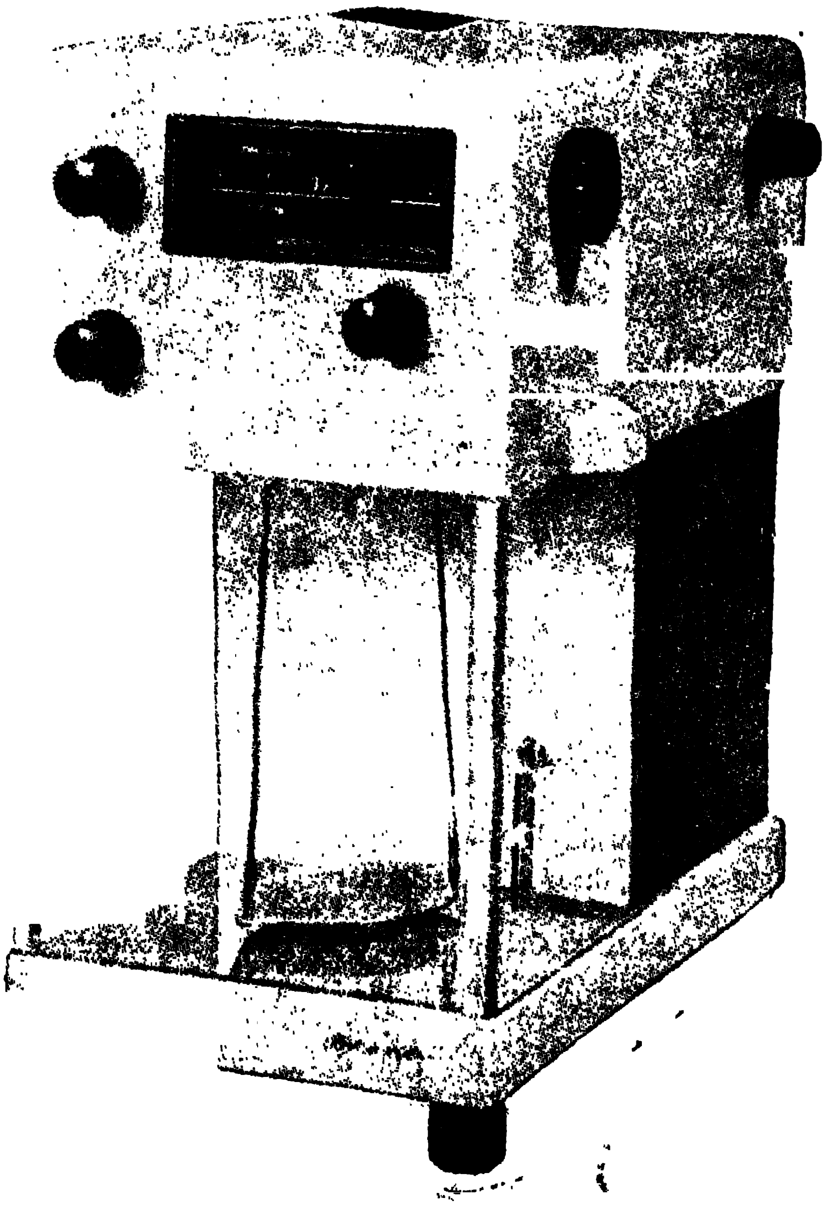

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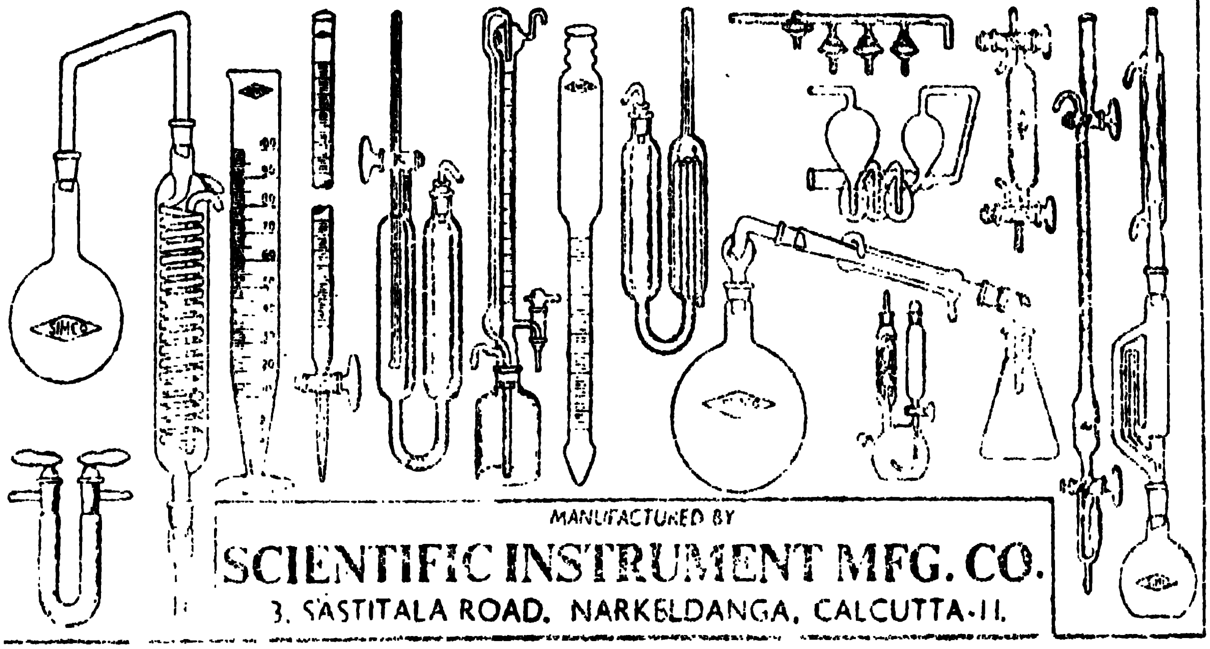

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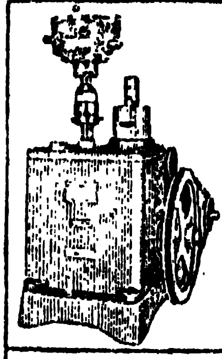

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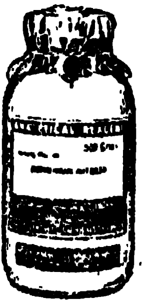

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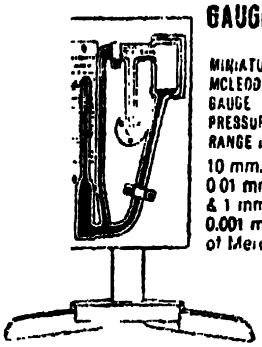

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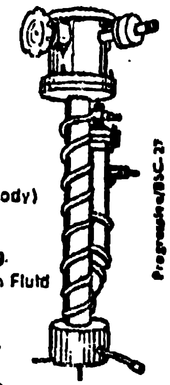

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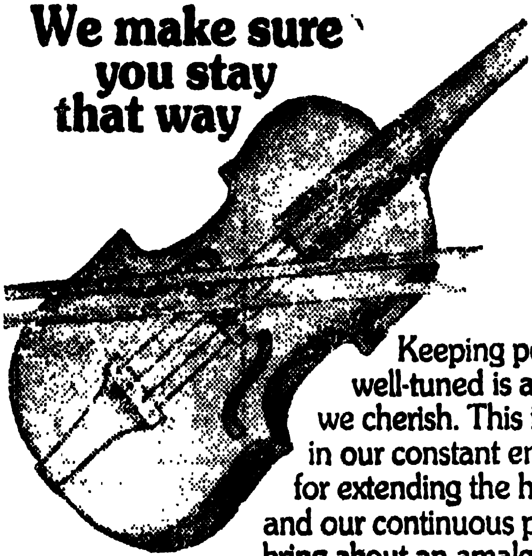

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CALCUTTA BEYOND 2000 A. D.

THE above title was the subject of a seminar held in Calcutta during February 15-17, 1984. The seminar was subdivided into ten sessions namely Population, Housing and Area Development, Traffic and Transportation, Health and Environmental Hygiene, Water supply and Drainage, Education, Industry and Power, Trade and Commerce, Communication, and Employment. Each session had a topic which was discussed by a number of speakers based on a key-note address. The time allotted for each topic was rather short in consideration of the importance of the problem.

An overall view of the problems of Calcutta and its citizens has been a subject of much discussion in recent times. After the partition, of India, population of Calcutta is greatly exploded. Moreover, an influx of population from the rural areas of West Bengal as well as from other states has complicated the development of the city in all respect. After independence, plans are devised by the authority to cope with the exploding population of the city. But these plans are sometimes criticised not to be tuned on an integrated base. In consequence, all the problems discussed in the seminar remain still unsolved. Footpath dewellers are increasing in number, transportation has been a nuisance, Health and Hygiene are at stake, a medium heavy shower over-floods the streets for hours, power failure is a regular phenomena, Telephones remain frequently dead, the education system is on the verge of a collapse resulting in a vast unemployment problem.

The aim and object of the seminar was to indicate the vastness of the problems to be envisaged during the next fifty years, at least. It is to be reminded that if a due consideration would have been given in the year 1950 A. D. to envisage the problems of Calcutta today and attempts would have been made to cope with those problems by proper planning, the present distress in the city life could be reduced to a large extent. This sort of planning for the future has been a regular feature in the developed countries and a subject named Futurology has emerged out of such ideas in scientific planning for the future.

India, through its five year planning combats with the problems of the people of the country. That these five year plans are not adequate is seen from the fact that the distress of people is not reduced. One of the reasons is that a due consideration is not given for the problems to be inflated in near future. We are now entering the seventh five year plan period. Planners of our country may now look forward at least for the next fifty years to draft a final plan for the country. It is also required that specific problems for a certain region of the country should not be over-looked. With this context, the Seminar on Calcutta Beyond 2000 A. D. was organised.

It can not be claimed that the seminar resulted in predicting unique solutions for all the problems. It rather emphasises that similar discussions on regional basis on the different problems by scientists, technocrats and planners be held before drafting an integral plan of the country. India does not lack in resources, it has enormous manpower, it has talented persons who can think of the right problems and can indicate the solutions. It is required to coordinate these ideas in practice to utilise our human and material resources to raise the country over the porverty line. □

S. B. Karmohapatro

BEES, POLLINATION AND MELIS SOPALYNOLOGY

JANA MAJUMDAR and SUNIRMAL CHANDA*

FOR ages bees, especially honeybees, have been proved to be very intelligent. They help in the production of crop wealth These insects contribute honey, which is one of the choicest free gifts of nature.

Bees as pollinator

Bees reveal a definite capacity for perception of form, size, colour, number, pattern taste and smell. By mobilising all such faculties workers of a colony become accustomed to a specific floral source for the collection of nectar and pollen. If the particular floral source is abundant, all the foraging workers of a colony may confine their visits to the same source. If it is not so, smaller groups in a colony may get conditioned to different floral types at a time. It may thus be observed that an individual foraging worker be confines its visits for a specific time to a single floral type as long as the flowering period lasts. This interesting behaviour of bees is called '*floral fidelity*' which explains their significance in pollination.

Most other pollinating insects drift at random from one source to another and therefore are not consistant pollinators. By virtue of their floral fidelity, honeybees are considered to be the most efficient pollinators.

If more than one crop are flowering simultaneously, bees fix their preference in favour of the plant species which produce more palatable and nutritive nectar and pollen, ignoring other species which, therefore remain unattended for pollination. In the case of weeds competing with the main crop, bees may often be artificially conditioned or deconditioned as to make them pollinate a particular crop by inducing visual, alimentary or olfactory reflexes[1].

Importance of bees as crop-pollinators has profound significance. If bees are protected against indiscriminate insecticide damage and are systematically used in Indian agriculture, they may give us additional

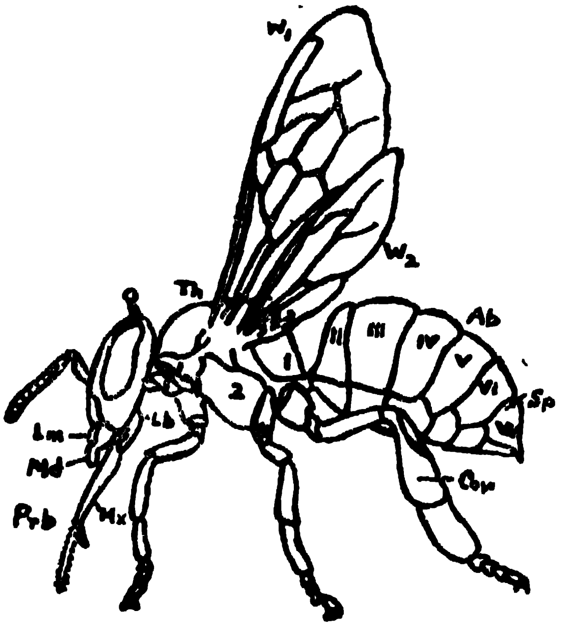

Fig. 1. Diagram of the anatomy of a worker bee, with the body hairs removed, showing the appendages of the left side.

1, 2, 3 : thoracic segments ; I, II, III, IV, V VI, VII : abdominal segments ; Prb : Proboscis Mx : Maxilla ; Md : Mandible ; Lm : Labrum Lb : Labium ; Th : Thorax ; W : Wing ; Ab : Abdomen ; Cor ; Corbicula ; Sp : Spiracle.

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*Division of Palynology & Environmental Biology, Bose Institute Calcutta-700009.

harvests. It has been found that prolific strains of bees with bigger bodysize and longer tongue-reach which, besides giving higher honey yields, can also serve as better crop-pollinators[2].

Insects which carry away pollen to feed their young, possess various collecting devices. The greatest specialization is met in Apis, in which the outside of the tibia of the third pair of legs is developed into corbicula, a special apparatus for the temporary storage and transport of pollen (Fig. 1). The weight of a pollen load carried in the corbicula of a honeybee is of the magnitude of 5-10 mg comprising some 50,000-10,00,000 grains[3], which in turn depends on the species and grain size. These grains are lost for pollination, but even the most highly evolved types of bees are incapable of getting rid of pollen from their pubesence.

Pollen as Attractant

When functioning as an attractant, pollen is generally well exposed and available also to visotors with a primitive organisation. Pollen odour plays a major role in releasing instinctive reactions in insects.

Pollen grains in the role of attractant are frequently produced in large quantities. Such flowers are recognised by having numerous stamens, whereas anemophilous flowers often have lesser number of stamens per flower.

Long, flexible stamens and the dryness of grains are the characteristics of wind-pollinated flowers, which are less suitable for insect collection. But some of the pollen grains of anemophiles, some times found in store of beehive, could possibly be transferred accidentally. Maurizio's investigations[3], however, proved that such pollen are collected systematically. It is not yet adequately known about the general existence of specific pollen odour, which, at close range could lead the visitor to the source of pollen.

Utility of pollen grains to bees

A bee colony collects about 30 kg of pollen grains every season which are used as a source of protein food for the larvae and the young bees. Many of the important pollen yielding plants are entomophilous (insect-pollinated) but they do not have nectar. Notwithstanding the fact that the protein food is collected, transported and stored separately from nectar and honey, some of the pollen grains get contaminated in honey. The ripe honey contains at least 100 pollen grains or more in 1 gm sample. These grains increase the nutritive value of the honey. The chemical composition of the grains from different plant species varies over a fairly wide range. Besides proteins, they contain fats, carbohydrates, minerals and traces of enzymes, hormones, vitamins, pigments and other components. The gross chemical analysis show that in relation to the amount of Carbohydrates and proteins, the variation of the mineral and fat contents occurs in a lesser degree. Carbohydrates and fibre residue, vary more between and within species. The carbohydrate content of grass pollen (corn) may be more than twice of average angiosperm pollen grains, whereas the quantum of carbohydrate in pine and most gymnosperms are considerably lower.

Proteins vary widely with species, usually accounting for 10-30% of the pollen dry weight. Lipid contents average 1.5-4% and may be higher in those with oils on the grain surface Mineral content usually is about 2-4% but may be as high as 7% in some species[4].

Pollen grains collected by bees induce more effective sugar reduction than those which are directly collected from the plants. The increasing reduction of sugars in the pollen grains collected by the bees is due to the bee secretions and addition of nectar to the pollen.

Table 1 shows the gross chemical analyses and Table 2 and 3 give some data regarding the carbohydrate and vitamin contents of the pollen grains of some common plants.[4]

TABLE 1 : Gross chemical analysis of pollen

Species	% Dry weight Minerals	 Carbo-hydrates	 Proteins	 Lipid
Zea mays	2.55	36.59	20.32	3.67
Typha latifolia	3.70	17.78	18.90	1.16
Pinus sabiniana	2.59	13.15	11.36	2.73
Pinus radiata	2.35	13.92	13.55	1.80

TABLE 2 : Pollen carbohydrates

Species	% Dry weight sugars Total	 Reducing	 Non-reducing	 Starch
Zea mays	36.6	6.9	7.3	22.4
Typha latifolia	31.9	0.05	18.9	13.0
Phoenix dactylifera	1.2	1.1	0.1	0.0
Pinus sabiniana	13.2	7.5	3.5	2.2

TABLE 3 : Pollen vitamin content

Vitamin	% Dry weight *Pinus montana*	 *Alnus incana*	 *Zea mays*
B_2 (riboflavin)	5.6	12.1	5.7
B_3 (nicotinic acid)	79.8	82.3	40.7
B_5 (Pantothenic acid)	7.8	5.0	14.2
B_6 (Pyridoxine)	3.1	6.8	5.9
C (ascorbic acid)	73.7	—	58.5
H (biotin)	0.62	0.69	0.52

Honey, a gift of nature

Honey is a valuable food and also has a great deal of medicinal property, and is considered as a substitute for expensive food. A tablespoonful of honey produces 75 calories of energy. The nectar gathered from flowers undergoes a chemical change in the abdomen of bees converting it into glucose and fructose and this invert sugars need no further digestion by the human stomach. This is one of the reasons why honey is such an ideal food for babies. Pollen contents of honey increases its food value considerably. Honey contains iron salts in the correct proportion required for the human blood and can be taken in as such. As a result, honey is good for anemic persons.

Since honey contains only simple sugars, it is valuable when a supply of carbohydrate in an easily assimilable form is required (cal. value ; 319 cals/100 g). Honey forms the basis of many preparations of Indian medicine. Being a demulcent, it relieves dryness and is prescribed for sore-throat, coughs, colds and constipation[5]. Honey is also useful in eye troubles. In every case of malnutrition, honey is simply a *sine qua non,* as it contains not only proteins, but mineral salts and vitamins which are missing in sugar.

Honey is the best healer of wounds and superior to all ointments. Honey sooths pain, hastens healing and acts as an antiseptic. It is also highly effective with burns and carbuncles. Honey does not attack the mucous membrane.

In the case of rhumatic patients honey dissolves uric acid while cane sugar provides it[6].

Melissopalynology and its significance

Pollen analysis of honey samples is known as melissopalynology. The technique of preparation is as follows: honey samples are diluted with distilled water, centrifuged and water is decanted. This process is repeated twice. The pollen samples are then prepared following acetolysis method.

Various morphological characters of the pollen grains render identification of the taxa up to species level. The analysis of honey may be applied in nature which are as follows:

(1) *Unifloral and multifloral honeys*: Honey samples, containing pollen grains from a single taxon are known to be unifloral. The unifloral honeys are usually marketed under the name of their source. Each unifloral honey has characteristic physicochemical properties. Consumer preferences for unifloral honeys are based mainly on these considerations. Pollen analysis in such cases serves to confirm the vegetational source of unifloral honeys.

A honey sample from Arambagh, Hooghly was analysed in our laboratory which contained only the pollen grains of *Brassica nigra.* This unifloral honey can be marketed under the name of its specific plant source, e.g. mustard honey. Another honey sample obtained from Barasat, 24 Parganas, showed only the pollen grains of *Mangifera indica.*

Pollen analysis of multifloral honey indicates the floral composition as represented by the spectrum of pollen variability of a composite floral assemblage. It can also reveal mixture of different honey samples as also their relative proportion approximately. Multifloral honeys are, however, more common.

A honey sample from Baruipur, 24 Parganas was found to be represented by a large number of pollen morphotypes. The dominating families were Barringtoniaceae, Convolvulaceae Apiaceae, Euphorbiaceae, Rhamnaceae, Lamiaceae and Cyperaceae followed by Bombacaceae, Brassicaceae, Arecaceae, Solanaceae, Myrtaceae, Acanthaceae, Polygonaceae and Asteraceae with plants like *Barringtonia* sp., *Ipomoea* sp., *Coriandrum* sp., *Zizyphus jujuba, Leucas* sp., *Cyperus* sp., *Bombax malabaricum, Brassica* sp., *Cocos nucifera, Datura metel, Eucalyptus* sp., *Polygonum* sp., *Tridax* sp.

(2) *Geographical origin of honeys* : Local floras have characteristic plant associations which are reflected in corresponding spectrum of pollen types represented in local honeys. This often enables one to identify the geographical origin of honey samples.

The honey samples show great differences in their microscopical contents, particularly the pollen types and also by their pollen frequencies. Pollen spectrum is characteristic for each sample and can be identified by' their pollen types indicating their place of origin. Thus for instance, the honey samples from Sundarbans are always characterised by the pollen types originating from Sundarban flora of mangrove types. The pollen grains of these samples come from Sonneratiaceae, Rhizophoraceae, Myrtaceae, Acanthaceae, Euphorbiaceae, Asteraceae, Plumbaginaceae and Capparidaceae. The pollen grains originate from *Sonneratia apetala, Rhizophora mucronata, Bruguiera gymnorhiza, Psidium* sp., *Acanthus ilicifolius, Excoecaria agallocha, Tridex* sp., *Aegialitis rotundifolia, Capparis* sp., etc.

Similarly honey samples collected from the Dooars area show a dominance of *Camellia sinensis* pollen grains along with some other local types.

(3) *Pollination preferences of bees* : Analysis of pollen-loads of bees returning from plants can reveal their relative preference for individual crops flowering synchronously within their foraging range. This may indicate competition between the plant species and varieties or between crops and their weeds in attracting bees. If bees are to be deliberately attracted to pollinate a certain crop, success or failure in their induced conditioning may be ascertained through the analysis of their pollen loads.

(4) *Diagnoses of honey* : Pollen nectar of poisonous plants may contain various toxic ingredients. Bees generally avoid such poisonous plants. But when there is acute shortage of food, probable starvation compels them to forage even on poisonous plants. Poisonous plants may be classified in relation to their adverse effects on bees or human beings or both. Thus for instance, pollen grains of *Lasiosiphon* sp. apparently cause no harm to bees but honey contaminated with these pollen grains are highly dangerous for human consumption. Conversely pollen of *Euphorbia genticulata* are highly toxic to bees with lethal effects but honeys contaminated with traces of this pollen seem to have no adverse effect when used for human consumption.[3]

Datura metel produces another toxic pollen type. It is toxic both to bees and human beings. The toxicity of *Datura metel* pollen is perhaps due to the presence of scopalamine[8].

Acute shortage of normal pollen during floral gap periods may sometimes compel honeybees to collect fungal spores deliverately as pollen substitutes. Thus, for instance, in the Western Ghat forests, there is acute scarcity of normal nectar and pollen during the floral gap periods around February. During these periods, bees have often been observed to collect fungal spores of *Cystospora oleae* a rust infecting the leaves of *Olea dioica*[3].

Some plant nectars show specific associations with certain yeasts depending on nectar composition. While foraging on such contaminated flowers, bees incidentally carry fungal spores or cysts and deposit them in the hive.

Various 'nectar yeasts' so far observed in nectars, honeys combs or in gastric tracts of the bees, include species of *Anthomyces*, *Sacharomyces*, *Zygosacharomyces*, *Mycotorula*, *Torula* and *Torulopsis*. ☐

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NOTES & NEWS

Quality evaluation of capsicum, ginger and pepper

The quality evaluation of the three spices, both in fresh and processed forms, has been made for two main sensory parameters: odour/aroma and pungency. Shanthi Narsimham of CFTRI, Mysore, treated both the parameters independently with a view to formulating a sensory-evaluation methodology and a functional relationship with the valid instrumental examination for quality.

Flavour-profile descriptors were developed, using TLC-aroma gram and column-fractionation techniques for ginger and pepper. Gas chromatographic (GC) fingerprinting was standardised for oleoresin oil. The physico-chemical constants like total ash, acid-insoluble ash and crude fibre for whole spice and refractive index, specific gravity, optical rotation of the volatile oil did not seem to bear any significant correlation to sensory quality both in ginger and pepper.

In pepper, oleoresin was reported by a panel to the more like ground spice and the oil completely unlike it. Flavour profile of pepper indicated the importance of top note, basic pepper note and their correct balance for evaluating over-all quality. The basic pepper note seemed to be due to high-boiling carbonyl compounds, which was confirmed by GC and sensory evaluation of various fractions.

A total of 18 flavour-profile descriptors and 20 aroma-impact areas in GC analysis of ginger were identified as important for total ginger aroma. A close relationship between respective principal components of profile and GC peaks was obtained. The independent over-all quality assessments were known to be highly correlated to the three main components taken together in each case ($R^{2} \sim 92\%$). Six GC peaks figured prominently in the three chief components. A step-up multiple regression based on them was found to be quite effective ($r=0.75$) in predicting over-all quality.

The sensory pungency was studied by Scoville tests, taking into account the experimental and other psychological errors. The results were expressed statistically for all the three spices. A linear regression was obtained between scoville units and capsaicin content estimated by paper chromatography in chillies ($r \sim 1$). In pepper, the pungent compound piperine was studied by spectrophotometric method for sources of variation in relation to the known properties. A linear regression with sensory pungency ($r=0.997$) was obtained. The sensory property of analogs and related compounds of piperine was also studied.

In ginger, contrary to the earlier observations, shogaol was found to be twice as pungent as gingerol. A multiple regression of both (6)-gingerol and (6)-shogaol on scoville value was shown to be significant and a predictive equation was developed. The correlation between predicted and determined values was highly significant ($r \sim 0.90$). □

CSIR News

A three-harvest crop with pigeon-pea

Scientists at ICRISAT have been working on pigeonpea lines that lend themselves to a system of three harvests from the same planting. Using ICPL 87 an early-maturing dwarf pigeonpea cultivar with high-yield in South Asia, they obtained a total of 5500 kg/ha from three harvest in 1982-83 and 3900 kg/ha from two harvests in 1983-84. Both values far exceed yields normally obtained in India.

The plants of this variety are short and need to be grown at a high density. As they are suited to sole-cropping rather than to inter-cropping, advantages must be obtained by harvesting more than once from the same planting. The crop matures in about 3½ months, so, if the first harvest is picked by hand, or by cutting off (ratooning) the top of the branches bearing pods, the plants can produce a second harvest or, under favourable conditions, even a third one.

ICPL is particularly suitable for this system, because it forms a flat-crop canopy and its pods are borne in clusters near the top of the plant. The variety is being already considered for release in Gujarat.

From sowings in mid-June, a first harvest (approx. 108 days after sowing) of 2380 kg/ha was obtained on a red soil in 1982 and 2700 kg/ha in 1983. A second harvest of 2120 kg/ha was obtained in 1982, bud-podfly damage limited yields to 1200 kg/ha in 1983. The insect damage also ruled out a third harvest, where 1000 kg/ha had been obtained in 1982-83. Prolonged monsoon rains delayed the first harvest in 1983 and may have affected later crop growth. The second harvest can be 55 days after the first and the third follows at a similar interval after the second.

Best results were obtained from a population of 16 plants/m^2. Diammonium phosphate was applied as a basal dressing at 100 kg/ha and 4-7 irrigations were provided. Endosulfan was used as an insecticide; spraying was easy because the crop was short with pods at the top.

Efforts are being made to multiply seed and adapt the system for black soils. □

At ICRISAT

Success with frozen embryo

The first authenticated birth of a normal baby resulting from a frozen-thawed embryo took place on March 28, 1984 at Melbourne's Queen Victoria Medical Centre (QVMC).

The freeze-thaw technique which made the birth possible was developed and performed by a team of scientists and doctors from QVMC, Monash University and Epsworth Hospital. The technique had important implications for human reproduction. It would improve the efficiency of in-vitro fertilisation (IVF) by reducing the risk of multiple pregnancies and decreasing the need for repeated surgery to collect eggs. Freeze-thawing would assist embryo donation, as better matching of donors and recipients would be possible by storing donor egg-embryos in banks. In potentially serious diseases affecting women, fertility might be ensured by storing embryos for future use.

The parents of the baby had a seven-year history of infertility resulting from diseased fallopian tubes in the woman. Attempts to remedy tubal blockage had been unsuccessful. During the woman's first treatment with IVF, doctors collected 11 oocytes (eggs). Ten oocytes were fertilised in vitro and two days later three embryos were transferred to her uterus. No pregnancy resulted from this attempt. Of the remaining seven embryo, six developed normally and were frozen in liquid nitrogen the next day – three days after fertilisation. Two months later, the woman returned for a second attempt at pregnancy. The three embryos which survived the freeze-thaw process were transferred to the women's uterus and a pregnancy developed. During the first few weeks, the pregnancy was complicated by hormone deficiency in association with an ovarian cyst. After treatment, the pregnancy developed normally till 36 weeks' gestation when foetal growth retardation with evidence of reduced placental function was diagnosed. An emergency caesarean section was performed under epidural anaesthesia resulting in the premature delivery of a normal healthy baby girl.

In its IVF program the Monash University has frozen 230 embryos and 40 have been subsequently thawed. The remaining 190 embryos are in storage. Of the 40 embryos thawed, 23 survived and were transferred, resulting in four pregnancies. □

Australian Information Service

Exciting fish fossils

Countless perfectly preserved fossils of small fish uncovered by machines mining the rich coal deposits of north-east Australia are adding to the understanding of how Australia and the other land masses of the Indian and Pacific oceans were informed.

The long extinct fish were killed and rapidly buried in an upheaval in a lake 240 million years ago in the centre of Queensland were being laid down. Australia was then part of the "super continent" Gondwanaland, which broke up about 100-150 million years ago and dispersed to form Antartica, Africa, India, South America and Australia.

The site has potential to yield complete specimens and probably provide further exciting discoveries of the fauna and flora that inhabited the region. The fossil beds are about 5 cm thick, containing hundreds of fish that are delicately preserved without decomposition or disintegration. The death and burial of the fish and any other plants or animals would have been extremely rapid, allowing perhaps a unique opportunity to study a late Permian lake community that was instantaneously sealed from oxygen and eventually fossilised intact.

Today these bands of ancient fish lie readily accessible (25 cm) under the surface, excellently preserved in the shale baked to a light red. The fossils are so abundant that in many of the specimens the fish are laid one over the other. The bones in the heads and scales, fins and gills can be seen clearly. □

Australian Information Service

SEMINAR ON CALCUTTA BEYOND 2000 A.D.

I. POPULATION

POPULATION IN CALCUTTA IN 2000 A.D.

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IN determining the probable size of the population and its living condition in 2000 and beyond we have to first emphasise that unlike Hong Kong or Singapore, Calcutta is not a city state but is one of the metropolitan cities of India. The future of the city therefore cannot be analysed in complete isolation from the economic development of India in general and the growth of other rival metropolitan cities of India in particular.

A fairly detailed analytical study of this problem with projections upto 1991 was done in a project in Applied Economics Unit, Jadavpur University and published in a volume entitled "Contribution to National and Regional Planning Problems"[1]. I can do no better than discuss some of the major features of the growth of Calcutta found in this study as compared to other metropolitan centres and the other features of the growth relevant to our discussion.

A study of the growth rate of population in Urban India and the metropolitan centres of Calcutta, Bombay and Delhi reveals that previous to 1960-70, Calcutta, Bombay and Delhi grew at a faster rate than the urban areas of India in general but that in 1961-70 for the first time this growth rate of Calcutta was below the urban growth rate of India as a whole though this did not happen to others, as shown in the table 1.

TABLE 1

	Decennial growth rate	
	1951-60	1961-70
Urban India	26.4	37.8
Calcutta	34.8	20.6
Bombay	38.7	43.8
Delhi	64.2	54.6

One may conclude that metropolitan centres other than Calcutta shared in the increasing urbanisation process but for reasons which we shall seek, this growth was not shared by Calcutta. The migrant flow in Calcutta was very uneven. Calcutta showed a declining percentage of the migrant upto 1931 but, jumped during 1940's particularly due to the war time employment prospects and continued rising in 1950 due to displaced migrants but fell back again in the sixties and seventies (Table 2).

TABLE 2

Metropolitan centres	Migrant as % of total population				
	1931	1941	1951	1961	1971
Calcutta	40.9	42.3	56.2	52.9	45.1
Bombay	75.4	72.6	72.1	64.2	54.8
Delhi	48.3	53.7	61.6	59.9	51.3

Thus if we omit the displaced migrants, Calcutta has not been attracting migrants in larger numbers, compared to Bombay or Delhi.

The major determinant of the growth of a city is industrial development unless like Delhi it has political importance as a capital of a big country.

The industrial profile of employment shows that industrial employment in Bombay rose from 40% to 53% against non-industrial falling from 58% to 47%. But in Calcutta this ratio of industrial employment has remained stagnant ranging from 36% to 39% (Table 3).

TABLE 3

Year	p.c. of industrial employment to total Calcutta	 Bombay
1931	33.4	40.3
1941	35.4	44.1
1951	34.9	46.4
1961	34.5	52.3
1971	39.1	53.1

It, thus, makes it quite clear that the industrial underpinning of Calcutta has weakned while that in Bombay has steadily improved offering more industrial employment.

During 1961-70 the growth rate of most industries in India had been positive, but in Calcutta out of 21 broad sectors nine showed a positive growth while rest were negative but in Bombay all but three showed a positive growth rate.

During 1961-70 again registered factory employment in the state of Calcutta fell in all sectors significantly whereas in Bombay the growth oriented sectors mostly showed positive growth rate. Using the employment generation as a pull factor and land man ratio of neighbouring states as a push factor a projection was made through a model which showed that there will be a marginal increase in migration into Calcutta against a substantial increase in Bombay (Table 4).

TABLE 4

Year	Net increase in migration (in 1000) Calcutta	 Bombay
1981	100	930
1991	103	1185

But the figure of employment showed that non-industrial employment in Calcutta will rise much more in relation to Bombay (Table 5).

TABLE 5

	Industrial employment (in 1000) Calcutta	 Bombay	Non-industrial employment Calcutta	 Bombay
1981	1749	1762	2700	1888
1991	3110	3166	4642	2665

These figures indicate the growing panperisation of Calcutta compared to Bombay.

Identifying employment as a pull factor and land-man ratio of neighbouring states as a push factor we get the following picture (Table 6).

TABLE 6

	β (Emp.)	r (land-man ratio)
Calcutta	1.143	−0.7944
Bombay	1.397	−2.1440

The pull factor thus in Bombay is higher than in Calcutta coming to the response of government demand (expense) as related to population the figures emerged as in Table 7.

TABLE 7

	β (g) per person
Calcutta	0.333
Bombay	5.399

The government demand thus rose by 5.3 person in Bombay whereas this rose in Calcutta by only 0.33 per person. Thus the resources controlled by government in response to population increase grew much faster in Bombay; nearly 15 times over Calcutta.

Coming now to overall population growth for the Calcutta Urban aggregation we get the following picture from our model for the future (Table 8).

TABLE 8

(in lakh)

	1971	1981	1991	2001
as per census	70	92		
as per model projection	65	89	121	164

The projection for such a long period obviously has many imponderables but still the model envisages substantial growth of the population over the next two decades.

But our earlier analysis shows that the employment opportunities, and government resource to look after this agglomeration continues to be stagnant at a low level and Calcutta will look more and more like a vast mass of underemployed and underpaid population leading to greater social unrest unless corrective measures are taken here and now. □

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CALCUTTA'S POPULATION BEYOND 2000 A.D.

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ALL over the world, and particularly in the developing countries, there has been a population explosion of the metropolitan cities and the urban agglomeration areas. The enormous growth of the city population and the urban agglomeration areas is two fold :

(a) growth due to high rate of natural increase ;

(b) growth due to a large volume of in-migration.

The policy makers and administrators involved in urban planning and urban development are facing challenging problems due to this unprecedented urban growth in terms of both rate and number. The problems are very acute in the developing countries, especially in regard to housing, sanitation, health, transportation, employment and a multitude of other problems.

Calcutta is one of the major cities of India growing very fast as Table 1 will show. For comparison, population growth of Greater Bombay has also been shown in the same Table.

TABLE 1 : Population Growth in Calcutta and Greater Bombay 1901-81 (Population in lakhs)

Area and percentage growth	1901	1911	1921	1931	1941	1951	1961	1971	1981
Calcutta urban agglomeration (CUA)	14.88	17.18	18.51	21.06	35.78	45.89	57.37	70.31	91.66
% growth		15.4	7.7	13.8	69.9	28.2	25.0	22.6	30.4
Calcutta Municipal Corporation (CMC)	9.34	10.16	10.53	12.21	21.67	26.98	29.27	31.49	32.92
% growth		10.8	3.6	16.0	77.5	24.5	8.5	7.6	4.5
Greater Bombay	8.13	10.18	12.45	12.68	16.86	29.67	41.52	59.70	82.27
% growth		25.2	12.2	1.8	32.9	17.6	39.9	43.8	37.8

From the table it is observed that growth has been very uneven over different periods particularly before the Sixties for all the three categories of population presented in the table. While growth in Calcutta urban agglomeration areas (CUA) has fluctuated within a narrow range during the last thirty to forty years the growth has declined substantially for the metropolitan city of Calcutta (CMC) over the same period. Growth in CUA remains at a much higher level compared to that of CMC. Bombay exhibits an increasing tendency of growth over time, the percentage growth remaining at a higher level compared to that of CUA. The current growth pattern of CUA indicates growth in housing in the outlying areas of the CMC. Due to unfavourable environmental conditions growth in housing development did not occur earlier in those places. With the present state of demographic picture of the city and in the background of relevant sociocultural and developmental factors let us investigate the plausible growth pattern and prospects of Calcutta population in the future. In this context we may perhaps recall what Berrier once said about Bengal—"The kingdom which has a hundred gates open for entrance but not one for departure." The remark is perhaps equally true for Calcutta.

It has already been stated that CUA exhibits growth fluctuating within a short range during the last forty years. The exponential growth rate (per cent per annum) prevailing over 1941-81 and 1971-81 are shown in Table 2. It will perhaps not be very unrealistic to make models on the basis of continuance of the present growth rates. Looking at Greater Bombay it appears the growth potentials of CUA will not possibly decrease in the near as well as in the distant future. This belief is re-inforced particularly in view of housing projects in the adjoining hinterlands of CMC and the heavy influx in these industrial areas from the neighbouring states as well as from the districts within the state. Moreover, the possibility of return migration from Calcutta metropolis to these suburbs cannot be totally ruled out.

TABLE 2 : Exponential Growth rate (CUA)

Period	r (percent per annum)
1941-81	2.35
1971-81	2.65

Note : $e^{rt} = P_2/P_1$

P_2 = population in the second census year

P_1 = population in the first census year

t = inter censal interval

r = exponential rate of growth

The results of such exercises are presented in Table 4.

Looking at Calcutta City (CMC), from 1941 onwards the growth has declined. The exponential growth rates are shown in Table 3.

TABLE 3 : Exponential Growth Rate (CMC)

Period	1941-51	1951-61	1961-71	1971-81
r (percent per annum)	2.19	0.81	0.73	0.44

From the above figures it is clear growth potential in CMC is declining rather at a faster rate. It will perhaps not be too optimistic to make the assumption that growth rate will decline more and more according to the logistic law of population growth and ultimately CMC population will stabilise. In fact, among the various methods used for projecting the city and urban population, Logistic and Gompertz law have been found successful. Firstly it appears CMC cannot accomodate too many people due to various problems of its own and it has already reached the optimum level. Secondly due to various developmental projects undertaken in the industrial belts comprising 'CUA—CMC', particularly the housing projects, there will be more and more concentration in those areas. Moreover, the declining trend in the observed rate of growth for CMC over the recent decades, a condition essential for fitting the logistic law of population growth, tells us the same story. Logistic curve has therefore been fitted as a growth curve for describing the population growth of Calcutta Metropolitan City. For fitting this growth curve population data for 1961, 1971 and 1981 have been used. The equation is given by

$$\frac{1}{P_t} = a + bc^t$$

P_t=population at time t

a, b, c are the three parameters. The upper asymptote is '1/a' and population will stabilise at this level. The projected populations of CMC according to the logistic model are also shown in Table 4.

TABLE 4 : Projected Populations of CUA and CMC (Population in lakhs) : 1991-2021

Year	CUA		CMC
	Series A	Series B	
1991	115.94	119.47	33.80
2001	146.65	155.72	34.32
2011	185.50	202.98	34.63
2021	234.65	264.56	34.81

Note : Series A : on the basis of r = 2.35% p.a.
Series B : on the basis of r = 2.65% p.a.

From table 4 it is observed that by the end of this century CUA will attain a figure lying between 14.66 and 15.57 million.

The recent United Nations estimate gives the population of Calcutta as 19.7 million in 2000 AD. In our view the U.N. estimate seems to depict a rather dismal picture of Calcutta's growth rate in the near future and there is no foreseeable reason to assume that growth rate will accelerate so quickly. In any case it should be noted that whatever estimate is given for Calcutta's population some amount of uncertainly is bound to remain and all the estimates are to be taken with some amount of reservation. According to our model the urban agglomeration area is likely to attain a population figure of about 15 million by the end of this century and about 25 million by 2021 AD. Looking at CMC it can be seen that the city population grows at a declining rate and the logistic model may perhaps describe the growth pattern satisfactorily. According to this model this metropolitan city will attain a figure of 3.43 million by 2001 A.D., 3.48 million by 2021 A.D. It will ultimately stabilise at a level of 3 50 million.

It is, of course, debatable whether CUA will maintain a steady growth rate and the CMC will follow the logistic law. We have just attempted to present a picture of Calcutta under some plausible models and the estimated population figures should be viewed in that perspective only. □

A NOTE ON CALCUTTA AND INDUSTRIAL REGION, 1951-2001

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WEST Bengal ranked fifth in urbanisation measured by proportion to total of urban population of India in 1981 against fourth in 1971. In India Class-I cities shared 54.4 per cent of urban population in 1971 against 60.37 per cent in 1981. In West Bengal, these cities accounted for 76.84 per cent of urban population in 1981. In other words, more or less, traditional pattern of urban growth continues with some exceptions. The urban population in Class-I cities in West Bengal increased by 42.48 per cent in 1971-81 against 56.83 per cent in the whole of India. The general increase of urban population in the same period was 31.54 per cent in West Bengal and 45.72 per cent in India.

Calcutta city based on 1971 boundary has a relatively poor and declining growth rate since 1951. Taking a rather mechanically optimistic view of the growth the population of the city is expected to rise to the order of about 0.6 per cent per annum up to 2001 on an average from 1881. The growth of Calcutta Urban Agglomeration also slowed down after 1961 showing some rise between 1971 and 1981 (Tables 1 and 2).

Historically speaking, the Calcutta city doubled itself between 1822 and 1872 and again between 1901 and 1941. The highest increase at 77.49 per cent took place between 1931 and 1941 (41.67 per cent even after accounting for inflation of population figures on communal consideration). There was also an increase of 24.50 per cent between 1941 and 1951 due to migration of displaced persons. The growth rate declined thereafter to come down to 0.44 per cent between 1971 and 1981. There is a negative growth of workers since 1961 with a noticable stagnation over the whole country. The Calcutta Urban Agglomeration, however, shows an increasing growth rate during 1971-1981. There is a complex set of factors for the stagnation in the city.

An analysis of the composition of population of Calcutta and the Industrial Region in 1951 shows that out of a total population of 4.63 million, 3.47 million were born in India among whom 2.34 million in West Bengal. In other words migrants from other parts of India accounted for 24.41 per cent and from outside India 25.05 per cent of the population of the Industrial Region. Displaced persons numbering 0.78 million constituted 67.24 per cent of the migrants from the outside India. The characteristics of population little varies

TABLE 1 : Total and Urban population of India and West Bengal, 1872-2001

(figures in million)

Year	India				West Bengal		
Year	Total	Urban	p.c. of urban to total	growth in p.c. (urban)	Total	Urban	growth in p.c. (urban)
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1872	214.81	21.85	10.17	—	14.98	1.54	—
1881	215.28	22.14	10.28	+ 1.33	15.25	1.53	- 0.65
1891	236.42	25.23	10,67	+13.96	16,14	1,73	+13,07
1901	238.40	25,85	10,84	+ 2.46	16,94	2.07	+19.65
1911	252.09	25,94	10.29	+ 0.35	18.00	2.35	+13.53
1921	251.32	28,09	11.18	+ 8,29	17.47	2.52	+ 7.23
1931	278.98	33.45	11.99	+19,08	18.90	2.90	+15.08
1941	318.66	44.15	13.85	+31.99	23.23	4.74	+63.45
1951	361.09	62.44	17.29	+41.43	26.30	6.28	+32.49
1961	439.23	78.94	17.97	+26.43	34.93	8.54	+35.99
1971	548.16	109.11	19.90	+38.22	44.31	10.97	+28.45
1981	683.81	159.00	23.25	+45.72	54.48	14.43	+31.54
1991*	849.98	226.46	26.64	+42,43	67.72	18.84	+30.56
2001*	1056.60	322.55	30.53	+42.43	84.18	24.59	+30.52

*Estimated on the basis of average growth rate obtained for 1961-1981

TABLE 2 : Population of Calcutta urban agglomeration and City, 1872-2001

(figures in million)

Year	Calcutta		P. C. growth of	
	U. A.	City	U.A.	City
(1)	(2)	(3)	(4)	(5)
1872	1.17	0.70	—	—
1881	1.10	0.66	- 5.98	- 5.71
1891	1.20	0.72	+ 9.09	+ 9.09
1901	1.49	0.93	+24.17	+29.17
1911	1.72	1.02	+15.44	+ 9.68
1921	1.85	1.05	+ 7.56	+ 2.94
1931	2.11	1.22	+14.05	+16,19
1941	3,58	2.17	+69.67	+77.87
1951	4.59	2.70	+28,21	+24.42
1961	5.74	2.93	+25.05	+ 8.52
1971	7.03	3.15	+22.47	+ 7.51
1981	9.16	3.29	+30.30	+ 4.44
1991*	11.61	3.49	+26.75	+ 6.08
2001*	14.72	3.71	+26.79	+ 6.30

* Estimated on the basis of average growth rate obtained between 1961 and 1981

between the Calcutta city and the Calcutta and Industrial Region together. The features of economic activities are also more or less similar where agriculture as a means of livelihood has no significance. In the Calcutta city, the tertiary sector plays a relatively important role.

In 1961 only 43.21 per cent of the total workers of the .Calcutta city were born in West Bengal and 37.21 per cent of the total workers were born in other states of India. No detailed migration data are available for 1961-1981. In view of the decline in major base of employment in jute industry, any appreciable new migration is ruled out. An analysis of migration data, as and when available, may throw some new light on the situation. On the whole, something of the order of more than 60 per cent of labour force in the industrial regions are from outside West Bengal.

The trend of population has been just discussed. A look into the trend of employment as indicated by the number of workers in the census reports is also alarming. There was a marginal rise in the number of workers between 1951 and 1961 in the city of Calcutta followed by decline in two decades ending in 1981. There are some discrepancies in definition and concept between censuses. In spite of these, the situation is at best a stagnant one. In the Calcutta Urban Agglomeration, the growth of workers was between 6.5 and 7.8 per cent during 1951-1971 lagging much behind the growth of population. But there was a sudden rise of 22 per cent between 1971 and 1981, the rate of growth of population in the same period being 30.5 per cent. It deserves a scrutiny but on the face of it this is unlikely to happen, although some rise in number of workers plausible. The following table 3 shows the comparative position.

TABLE 3 : Calcutta city and Calcutta Industrial Region : Area, Population, Workers and Non-agricultural Workers, 1951-1981*

(number in million)

Year	area in sq. miles		population		workers		non-agricultural workers	
	City	UA	City	UA	City	UA	City	UA
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1951	38.92	161.03	2.70	4.63	1.16	1.96	1.15	1.94
1961	39.80	180.10	2.93 (+8.48%)	5.62 (+21.42%)	1.18 (+2.09%)	2.08 (+6.45%)	1.17 (+1.62%)	2.05 (+5.43%)
1971	40.21	203.03	3.15 (+7.57%)	6.86 (+22.05%)	1.17 (−1.46%)	2.25 (+7.79%)	1.16 (−0.93%)	2.21 (+8.17%)
1981	40.21	203.03	3,29 (+4.54%)	8.95 (+30.50%)	1.15 (−1.36%)	2.73 (+21.63%)	1.14 (−1.44%)	2.69 (+21.63%)

* Data for 21 Non-Municipal units of Calcutta Urban Agglomeration have been omitted for the year 1961 and 1971 and proportionately reduced in 1981. The area of UA in 1951 is unadjusted.

The growth of Calcutta city or of the Urban Agglomeration is dependent on the growth of non-agricultural sector, specially, those of secondary sector. The non-agricultural sector is growing very slowly to lag behind population almost during the whole of 20th century in West Bengal as a whole. The number of self-supporting persons declined from 3.47 million in 1901 to 2.89 million in 1931, to rise again to 4.12 million in 1951. The industrial employment as revealed by self-supporting persons or workers obtained in census operations followed a similar trend. In this background, the situation after the partition of Bengal did not improve in spite of political independence and five-year plans. Two major industries of West Bengal based at the Calcutta industrial region—jute and engineering—were constantly in crisis with a fluctuating and declining trend both in output and employment. The number of registered factories and average daily employment, more or less, remained at a constant level in 1970's throwing a large number of new entrants in the labour force out of the orbit of employment.

While there has been an investment in infrastructure with some results, there is little investment in secondary sector to generate a cumulative process of employment. The Calcutta and industrial region and the West Bengal as a whole is in a dearth of investment for decades. The city of Calcutta reached a saturating point perhaps before 1961 in respect of absorbing new migrants. The industrial region is going to follow the same trend. As such, until some extra-ordinary factors are in operation the population of the city and the agglomeration may continue to grow slowly in number with a stagnant productive base.

The quality of urban growth in the recent years are also sometime regressive. Asok Mitra showed the trend of declining towns and declining means of livelihood in the West Bengal Census Report 1951 (Vol. 6, Part 1A). While functionally productive towns declined generally, there has been some rise of urban centres based on employment generated by expansion of white-collar administrative infrastructure. Some conscious attempts are, however, being made to improve the quality of urbanisation in the CMDA area in West Bengal. A trend of 'below subsistence urbanisation' prevails for a long time in history. It implies, among other things, inadequate amenities of life where migrants live in worse surroundings than those obtained in their rural abode. Desparately, people still flock in city slums of Bombay and Calcutta.

A rural surplus is usually calculated on marginal principles implying that production will not fall if a part of workers are withdrawn. In other words, marginal production of a section of population is zero. If we apply the same technique to find out the urban surplus, the toll will be heavy presumably from 30 to 50 per cent of white-collar occupation. An urban growth based on administrative infrastructure may be intrinsically negative in character. The new plant or new sites offering fresh productive employment had been relatively inadequate in the context of population growth in the whole of India. The brunt is therefore borne by West Bengal and Maharastra. These two states absorbed something of more than 30 per cent of rural migrants of India as estimated in 1961.

According to the estimates for the new sixth plan, the back log of unemployment in 1980 was 12.02 million. There will be an addition of 34.24 million in the labour force during 1980-85. Total unemployment projected thus stands at 46.26, With expected generation of new employment at 34.28 million, the backlog at the end of the sixth plan in 1985 is estimated at 11.98 million. The actuals are however unknown. The rate of the growth of urban labour force is higher than that of the rural and creation of new employment opportunities is not much brighter. The future of Calcutta or West Bengal cannot be defferent from that of the rest of India, particularly when the state is traditionally neglected by the central authorities.

The authors are grateful for active collaboration of Sm. Swagata Gupta.

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'QUO VADIS ?'
THE DEMOGRAPHIC RIDDLE OF CALCUTTA

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CALCUTTA has many critics but few lovers. Even those who love the city do so, but of a romantic attachment to the city, not polluted by the touch of reality. The author in 1979 had ruefully observed that Calcutta was not growing fast enough till 1971. The anguish caused by the slow growth of the city has not abated even a little, since the decline in the growth of the city's population has been registered by 1981 Census too. The decadal growth rate of the Calcutta's population has been 4.96 per cent, a figure indeed quite appalling. The decadal growth of the city in 1941-51, 1951-61 and 1961-71 had been 24.5, 8.5 and 7.6 percents respectively. Some scholars might point out that even if Calcutta had declined, Greater Calcutta had grown. To this, the author has several objections. What is exactly conveyed by the term 'Greater Calcutta'?

Does the term connote Calcutta Urban Agglomeration? If so, which Calcutta Urban Agglomeration? Is it the Calcutta Urban Agglomeration of 1971 or of 1981? Some might equate Greater Calcutta with Calcutta's Standard Urban Area. To this also one may pertinently raise the question of date. Which Calcutta Standard Urban Area? Does it refer to 1971 or to 1981? Some scholars often equate Greater Calcutta with Calcutta Metropolitan Area, as defined by Calcutta Metropolitan Development Authority. The author is afraid that this approach is also equally vulnerable for the simple reason that Calcutta Metropolitan District may have to be delineated again in view of changes in the Calcutta Standard Urban Area in 1981. Some observers fancifully compare Greater Calcutta with Greater Bombay. To this the objection will be regarding the different status of the two cities. Whereas Greater Bombay is under one municipal corporation. Greater Calcutta, whether one equates it with Calcutta Urban Agglomeration, or Calcutta Standard Urban Area or Calcutta Metropolitan District, is not?

Therefore, the present discussion will centre round Calcutta City, the capital of West Bengal, which has also undergone changed in jurisdiction after 1981. The present discussion will be quite limited in scope because of paucity of 1981 Census data which are still under processing in the computer. The author hopes that he may be excused for the very limited scope of discussion and also for his limited capacity for demographic forcasting about the city's potential beyond 1981. The limitations will be unravelled subsequently. Suffice it to say, many demographic features about the city for 1961 1971 have been enigmatic. Even those who are interested in Greater Calcutta, which in common parlance may stand for Calcutta Urban Agglomeration, will be shocked to know that whereas Calcutta Urban Agglomeration with 74 contiguous urban areas including Calcutta proper had grown by 22.6 per cent in 1961 71, Calcutta Urban Agglomeration with 107 contiguous urban areas in 1971-81 had registered a growth of only 23.90 per cent.

Before one attempts to explain the strange demographic behaviour of the city of Calcutta, one should first attempt to know the demographic features of the city and thereafter, attend to analyse the trend thereof. Contrary to all expectations, Calcutta's pavement-dwellers after registering the fantastic, growth of 166.4 per cent in 1961-71, became almost an extinct tribe. Instead of swelling the numbers, the house-less population of Calcutta city declined by 22.97 per cent in 1971-81. Is it because of the vanishing balconies or because of newly sprung-up shanties which have been taken care of by the housing Census in 1981? Published data later will throw further light on the mysterious phenomenon.

Calcutta was once famous for the messes, boarding houses, chunmeries, etc., which find reflections in many short stories and novels of eminent Bengalee writers. But alas! the institutional population too fared no better fate in Calcutta city. The decline in the institutional population continued unabated. The decadal decline in 1961-71 was 25.4 per cent. But in 1971-81 it was 75.58 per cent. Leaving aside the institutional and houseless population, population living in normal households with ties of blood and marriage and living in houses grew at a pace of 9.92 per cent in 1961-71 and at 7.76 per cent in 1971-81. Here too the growth has declined.

That the housing situation in Calcutta is partly to account for the declining growth of Calcutta's population was discussed in details by the present author in the paper referred to. Therefore, the detailed data are not replicated here. However, the same discussion was confined to the housing data of 1961-71. The 1981 Census data are yet to be made available. The perception of the author is that the situation has not improved.

From housing, one may turn to the employment situation. The analysis of the working population in Calcutta was presented by the author in a paper in 1980. Calcutta lost during 1961-71 a total of 17247 workers at the decadal declining rate of 1.5 per cent. The decline in 1971-81 continued at 0.34 per cent resulting in a net lose of 4012 workers in the decade. In 1961-71 the male workers dwindled at the rate of 1 7 per cent. In 1971-81 they registered a decline of 1.86 per cent. But the growth rate among the female workers has been fantastic indeed! From a growth of 2.4 per cent in the decade 1961-71, the growth of female workers in 1971-81 shot up to 25.67 per cent. The dispersal of the city's population to the new urban areas and suburbs of Calcutta city which constitute the urban agglomeration may be one of the factors for the decline in male workers. One should not make from the data about the working population of Calcutta a hasty conclusion that the city has lost its economic potentiality. It is commonplace, though without any statistical back-up figures, that the number of commuters has increased enormously with improvement in the means of transport, by way electrification of railways and also extension of the city's suburban bus services into the heart of the city.

It has been observed that 56.5 per cent of the non-agricultural workers in the rural areas of Calcutta's Standard Urban Area commuting to different areas of Calcutta's Urban Agglomeration in 1971 came to Calcutta alone. It is anybody's guess as to what the number of commuters from outside the Calcutta's Standard Urban Area and also from different towns and cities within Calcutta's Standard Area and outside to Calcutta could be.

That Calcutta is receiving less immigrants has been discussed in details in the paper of 1979. Suffice it to say, Calcutta lost in 1961-71 decade 387890 immigrants from outside West Bengal. In the same decade the immigration from different districts of this state also suffered a decline to the extent of 92,364. Against this setting, one may look at the emigration of population from Calcutta city to other districts of West Bengal. The growth in absolute number of emigrants in the decade 1961-71 was 146766. Whereas in 1961 the number of emigrants from other districts of the state to Calcutta outnumbered the emigrants from the city of Calcutta into other districts of West Bengal by 101474, the trend was reversed in 1971. In 1971 the emigrants from the city of Calcutta into other districts of the state outran the number of emigrants by 65074. Outflow of Calcutta's population is evidenced further by the figures culled from the Sample Registration Scheme. The migration effect for the years 1971, 1973, 1975, 1976, 1977, 1978, 1980 and 1981 have all been negative (2.6, 0.7, 1.8, 1.7, 3.2, 0.69 and 0.54 per cents respectively). The natural growth for all these years have been higher but the net growth is lower. Despite the ambitious desire to dilate further on the demographic situation of the city, the author is handicapped by inadequacy of data. It is no use repeating the discussion made in the papers already cited. The explanation of the loss of Calcutta's population and slow growth will be at this stage hypothetical in the absence of solid statistical data. The author, however, as a robust optimist, if not a romantic lover, has the hunch that Calcutta is loosing its middle class population who are land-hungry without the means to acquire it and build a house thereon in the city of Calcutta proper. Many of them have flocked into the outlying areas which were hitherto villages and are now christened as neophyte towns of 1971-81 constituting Calcutta's Urban Agglomeration. If the residents of Calcutta have shifted to a different place, can they still claim to be a Calcuttan? Perhaps not, because one municipal umbrella is missing over the so-called Greater Calcutta. ☐

II. HOUSING AND AREA DEVELOPMENT

HOUSING AND AREA DEVELOPMENT
(Key-note Address)

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THE basic need for a man is food, clothing house. House is the nucleus of human activity where he lives, works and raises his family. It has an important role in shaping our life and character. Despite the country's achievements in other spheres, we are yet to take emphasis on the problem of housing for the teeming millions of common people. Economic and social characteristics of a society are clearly reflected on the pattern of its housing. Though a poor nation like us have a few number of well built dwelling units, but the major sections of the people coming under the category of below the poverty line have no other alternative but to live in filthy dwelling or even without any shelter, Unequal societies are revealed by their wide diversity of housing forms. Housing clearly indicates the economic and demographic structures of a society, its level of development, distribution of its income, the rate of population growth and the pace of urbanisation.

Approximately 70-80% of the population of our country, largely dependent upon agriculture for their subsistence, lives in rural areas that are generally backward economically. Although 'Regional Development' have been taken up, major investment decisions are still made at the national level and the regional development authorities have not been given the means to perform the tasks for which they were created. The rural economy has not been accorded the same importance as the urban economy, resulting not only in large-scale migration of rural population to the urban areas and increased concentration of industries, services and facilities in the latter, but also in dual economy.

The existing shortage in housing in Calcutta (which in the proper sense should be considered for the CMD area) is immense. It is difficult to find even a modest accommodation at a reasonable price and this has resulted in lakhs of people living in filthy slums, which are spreading like tentacles into the finest areas of the city and creating problems of its sanitation and hygienic almost everywhere.

The total population of CMD area was 8.33 millions in 1971. Out of which 3.15 millions live in the city proper. Besides, Howrah and other 32 municipalities within the CMD area, there are 65 non-municipal urban areas and 500 rural mouzas within the CMD area. Though the growth in the city proper for the last 20 years is negligible but the same is quite considerable in the Calcutta Urban Agglomeration areas within the CMD area. It is expected that by 2000 A.D. the population of CMD Area will increase to about 14 millions. This will mean growth of house-less population as alarming. The pressure on the available land in urban areas in particular, will be very high. The present trends indicate that the process of urbanisation is irreversible. To a large extent it is a condition for and that the consequences of rapid economic development and industrialisation. Problems of over-crowding, congestion, unsanitary living conditions and slums and squatter settlements in urban areas are attributable partly to the fact that urban development and rural development were not planned and undertaken in a regional context. In view of above, Government should adopt a policy aimed at balanced development in rural areas so that large-scale migration of rural population to the urban areas are to some extent arrested. First priority should be given for establishment of new rural based service centres, commercial, cottage industries, etc. This will create job opportunities for rural population.

Development planning should be a comprehensive and multi-dimensional process, involving the integration of economic planning, social planning and physical planning within a well defined framework at three levels: macro-planning, micro-planning and regional planning.

It may be mentioned here that though the CMDA has given importance in the improvement of infrastructures of the city proper, this is/would be creating a tendency of rush of population into the city and CBD Area in particular (namely the area between Burrabazar-BBD Bag to Acharya Jagadis Chandra Bose Road). Unless the major business centres along with important Secretariats of the Government are shifted to nearby growth centres, population influx during peak hours of the day in the CBD Area will create traffic as well as health hazards by 20 0 A.D. Naturally, decentralisation of big business centres as well as important Government offices are to be made in a planned way.

It may be desirable to deal with the problems of human settlement both in urban and rural areas and the environmental requirements simultaneously. It is required that the programme and policies are well co-ordinated with the industrialisation and urbanisation programme in the matter of housing as well.

Desirable objectives of such integrated planning should include:

(a) Minimising process of migration by establishing better linkage between rural and urban areas and by developing service centres and growth centres to provide adequate distribution of goods and services.

(b) Correlating investment with environment programme to arrive at criteria for location of human settlement.

(c) Providing incentives for the development of the least previleged sections of the society and for the undeveloped areas to provide better economic opportunities and social justice. Planning of human settlement, establishes harmonious relationship among various components of human settlement. Planning strategy should ensure the co-ordinated policy for accessibility to the infrastructures for optimising efficiency of the distribution system in conjunction with transportation and communication net-work as well as services (potable water supply, sewerage, drainage, etc.) to provide equitable socio-economic benefits to the population.

There should be planning for development of servicing centres and growth centres depending upon the policy adopted at the sub-regional level or local level. The action programme for optimum utilisation of existing infrastructures, services and land shall require scientific techniques for appropriate management of available resources. Consideration for urban land policy may include further thinking on ownership, taxation, type of use and intensity of use of land.

The Planning strategy should include the following considerations:

(a) Policy for house—Including place of work, living and for social services, such as health and education.

(b) Policy for infrastructures—Including types of transportation and road and rail net-work, energy grid and communication system.

(c) Policy for services including availability of potable water supply, drainage, sewerage, waste disposal and its possible re-utilisation.

(d) Policy for management—Streamlining and reinforcing of existing institutional framework and legislation for optimising the distribution of socio-economic benefits to the optimum number of people.

(e) Policy for the protection of environment—Including services preservation and utilisation of areas for cultural, scenic beauty, environment of aesthetics, pollution control to ensure that there is no ecological imbalance.

The Housing programme requires considerable amount of financial resource, land, material and institutional capacity. Though it is desirable to take up such a programme which will not only cater to the needs of additional houses that would be coming up in future, it should also fill up the present shortage and arrest further deterioration of the existing housing stock and finally improve the present situation.

The total requirement of land to house 4.5 millions additional population over 1980 that would be coming up by 2000 A.D. is 48500 acres on rough assessment and if we provide each new family with a plot without considering the question of availability the total fund that will be required for developing the total land requires for housing by 2000 A.D. is of the order of Rs. 250 crores. Considering the average household size to be 5 persons per household, the estimated number of households would be 2.80 million in 2000 A.D. The number of households in 1981 were 1.98 million in CMD Area. Thus the number of additional household that should come up by 2000 A.D. is 8.2 lakhs. Out of this, requirement for EWS people will be about 6 lakhs. Considering cost of a D. Unit at a very modest sum of Rs. 10,000/- per unit, fund required will be to the tune of more than Rs. 600 crores, excluding cost of development of land (Rs. 250 crores).

It may be hardly possible to take up such a housing programme within the limited resources and land. In view of limitations the first aim should be to provide 'sites and services' and some community services to EWS people instead of building housing units, for which land to be acquired and developed. As the cost of construction of a building unit has gone up very high within the last few years it has become practically impossible to build a a minimum habitable dwellings unit at 'minimum' cost standard for most urban families unless subsidised.

Self-help is the only means at the primary stage, which leads to subsequent upgrading at a later stage with the economic development of the family. Better housing in terms of space and construction standards is generally of lesser priority to those poor urban families than better employment, health, water-supply, education, etc.

The sites and services concept as a low cost alternative affordable to Economically Weaker Section of the community is perhaps a better solution for housing than any other ambitious programme. The simplest construction standards, works and lower unit cost involve in sites and services schemes, is more realistic and acceptable to the society. The scheme is unique in the sense that there is less subsidy involved for EWS. The differential pricing of the marketable land for the various uses enables provision of cross subsidy within the scheme itself. The cost of land for EWS people will be very nominal and the subsidy is made good by suitable pricing of the industrial, commercial and higher income group plots.

Scope of sites and services should come under the ambit of Area Development Programme which may include :

(a) Essential components such as building plots with provision of water-supply, sanitary, waste disposal, access ways, street-lighting, etc.

(b) Social services like health and educational facilities, community centres, post-office, recreational areas, sites for market and commercial activities, sites for small industries and handicrafts, etc.

(c) Various kinds of technical assistance in the management and monitoring of the projects which may extend the assistance in self-help construction methods and other ancillary works and in supervising financing in connection with small industries components of the project.

The broad objectives for a new area development scheme may contain the following sub-heads :

(a) To create opportunities for all income groups of people.

(b) To create job opportunities and promote new growth of commercial and industrial centres.

(c) To generate sufficient surpluses to apportion as a revolving fund.

It is expected that an all-out effort would be taken to provide at least a plot to each family by 2000 A. D. In case, the same is not possible, the problem will be aggravated due to further increase of population in CMD area beyond 2000 A. D. From 2000 A. D. the population growth in CMD area, with the present rate of growth, will mean addition of yearly population of 3 10 lakhs. To cater to the needs of this additional population, the number of dwelling/housing plots that will be necessary will be roughly 62,000 per year. Keeping this in mind, a long-term planning should be made for acquisition of land. As the environmental programme in the Calcutta city is very much aggravated, the proper approach will be to acquire land in low-density area for development of the new growth areas. ☐

CALCUTTA HOUSING

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PRESENT Calcutta has not grown-up as a planned city. Major attractions to this city have been its traditional importance, glamour amenities, educational and employment/business opportunities, etc. Basic facilities are gradually becoming inadequate due to crowding in the city. One such facility is housing, which is becoming difficult day by day.

The purpose of this study is to examine the existing housing facility in the *area under the Corporation of Calcutta* and to assess its look beyond 2000 A.D. It is also aimed to identify some of the factors which are deterrent to the housing development. Focus is on housing for residential purpose. Basic data used for this study were collected in connection with the Calcutta 1976 survey [1-3].

During 1976, there were 199,821 struc-

TABLE 1 : Percentage distribution of structures by the number of storeys and the type of utilisation

Type of utilisation	Number of storeys 1	2	3	4+	Total
Purely residential	42.48	17.84	5.67	1.30	67.29
Purely commercial	11.21	0.78	0.27	0.15	12.41
Mixed with residential	7.45	5.56	2.89	1.28	17.18
Others*	2.20	0.49	0.26	0.17	3.12
Total	63.34	24.67	9.09	2.90	100.00

*Includes schools, colleges, temples, etc, tures in the city, excluding the pavement dwellers shacks and hutments. Based on a 30 per cent simple random sample of the 100 wards, the structures are classified in Table 1 by the number of storeys and the type of utilisation.

TABLE 2: Distribution of households and persons by the type of structure

Type of structure	Percentage of	
	households	persons
Pucca roof	56.84	53.69
Pucca wall & non-pucca roof	24.11	25.47
Tin/asbestos/wood wall & non-pucca roof	8.01	8.08
Others (thatched & mud wall)	10.83	12.70
Non-reported	0.21	0.06
All types	100.00	100.00

From Table 1 it is clear that 85.47 per cent of the structures are used for residential purpose. Over 59 per cent of these are single storeyed, of which less than 7 per cent are *pucca* (during 1976, there were 96,327 pucca structures in Calcutta).

TABLE 3: Percentage distribution of households by per capita floor area (sq meters)

Floor area	Households
0	14.54
less than 1,5	14.92
1.5— 2.5	14.66
2.5— 3.5	11.43
3.5— 4,5	9.73
4,5— 5,5	6.53
5,5— 6.5	3.75
6.5— 7.5	3.33
7.5— 8.5	2.71
8.5— 9.5	1.76
9.5—10.5	3.18
10,5—11.5	1.54
11.5—12.5	1.80
over 12.5	9.01
not reported	1.11
Total	100.00

Table 2 gives the living condition of the people in Calcutta. It is observed that over 12 per cent of the population live in mud wall and thatched structures.

Table 3 gives the per capita floor area available to household members. It reflects the nature of over crowding. It is noted that 14.54 per cent of households do not use any floor area. This is mainly because of the two reasons: (i) the full time domestic servants, forming separate households not having any specific floor area allotted to them and (ii) the persons who are allowed only to keep their belongings in a room, are classified as having no share of the floor area.

Table 4 gives the occupancy status of the households and persons. It is seen that only 12.57 per cent of the households with 20,61 per cent of the population live in their own homes.

The area under the Calcutta Corporation is approximately 37 sq. miles. Various types of structures, both for residential and commercial use, cover about 85 per cent of the area. Due to overcrowding at homes, where over 13 per cent of the households have less than 2.5 sq. meters of floor area for every family member, it is only natural that they look for an open place. However, the area under parks, playgrounds, and the Maidan, covering only 4.43 per cent of the area, is too inadequate forcing people onto the streets. Road area, covering only 9 per cent of city' area, itself is inadequate for the traffic let alone the extra pressure from the people forced onto the streets. Day to day increasing number and duration of religious festivals and fairs in open places and streets and pavement shops, also compound problems.

TABLE 4 : **Distribution of households and persons by occupancy status**

Occupancy status	Percentage of household	Persons
Owned	12.57	20.61
Rented	59.43	66,03
Others*	21·12	11·37
Not reported	6.88	1.99
Total	100.00	100,00

* Includes quarters, disputed tenancy, etc,

By the end of this century, Calcutta population is expected to cross 3,700,000 (Decadal increase of Calcutta census population from 1951 has been about 2 lakhs with a decreasing trend). With the existing availability, many more people will have much less per capita floor area available at home and increase the number of pavement dwellers (there were 63,585 pavement dwellers in the city during 1977-78).

Since more than 63 per cent of the buildings are single storeyed and only 11.55 per cent of these are pucca, there exists vast possibility for housing and area development. However, over 87 per cent of the households do not live in their own houses, and these people are unlikely to be interested in investing for the development of their housing units. Landlords also do not want to invest because of non-profitable return because of the existing tenancy acts. The slum development programmes of the CMDA, where existing structures are unaltered, only guarantees the existence of the slums and poor housing conditions.

Thus, Calcutta beyond 2000 AD is likely to be a complete chaos.

Based on the facts and figures and the discussion, following two suggestions are made for housing development.

(1) Existing tenancy acts may be suitably modified so that the landlords' investments become profitable. With a housing development scheme, duly approved by the authorities, it should be easy for the landlords to evict the tenants.

(2) Government investments on private property, including slum development, may be discontinued. Such resources can be invested for educational, business, housing and area development in areas outside Calcutta. Better living condition outside the city will attract people to reside outside.

The author appreciates the help from Shri M. B. Chakraborty, Shri A. Roy-Chowdhury, and Shri P. Dey for preparing Table 1. ☐

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A STRATEGY FOR DEVELOPING FRINGES OF CALCUTTA

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C.M.D.A.

Calcutta

BY 2000 AD we expect Calcutta to take a stabilised shape, when rate of growth of population in the metropolis is expected to be minimal. It is also expected that by that time a rational urbanisation pattern of the State has taken shape, and that the medium and small towns have absorbed their due share of population. To achieve this, however, we need a strategy of land development ; and in this workshop devoted to Housing and Area Development, let me examine a typical slice of land comprising of a strip of urban area, a strip of sparsely developing area, a strip of petential urban land, a strip of land that must remain vacant due to ecological considerations but is vulnerable for urbanisation, and a rural strip beyond the boundary of the Metropolitan District. For the purpose of this presentation I would take up a slice from the 11,000 acresite in East Calcutta contemplated for development of a township in the foreseeable future. The views presented here are indeed that of the undersigned and not official view of the CMDA. Since the question of bringing all these lands into public ownership through land acquisition is an expensive proposition, I would like to suggest different strategies for different kinds of lands. In short, these are as follows :

(i) For urbanised fringe, we have not much scope for improvement. Here, I recommend requisition of derelict tanks and waste lands for requisition under the WB Waste Land (Requisition and Acquisition) Act, 1952, and handing over the same to appropriate social welfare organisations for maintenance and economic exploitation by pisciculture, duck rearing and the like. This way with minimal or no expenditure, or even at profit the preservation of these tanks and lands may be ensured for the next 20 years.

(ii) For the next strip, where development is sparse, the only solution is consolidation and re-parcelling of land. This is also known as reconstitution of plots and is workable under the provisions of the WB Town and Country (Planning and Development Act) 1979. Under this scheme contiguous plots of an identified project area are re-subdivided to obtain roads of adequate width and reasonably straight and smooth alignment. Also by this process plots are made more or less rectangular for better utilisation of the buildable capacity of the concerned plots. For the lands required for road widening and for exchange with the neighbouring plot owner, payment of compensation is not required. Thus by this technique, and virtually by spending no money, the concerned plot owners can get a better subdivision. If reconstitution of plot boundaries is put as a precondition for further development of infrastructure by the concerned public Agency, I am convinced that the venture would be a success.

(iii) With this slice taken for presentation we have a strip of Eastern Metropolitan Bypass on both sides of which for the present we have vacant lands. Because of high pressure of urbanisation I feel the strip along the West of the Bypass may be permitted for urbanisation. Here, I feel Government may go in for acquisition and development of land except the registered Housing Co-operatives who are willing to accept the development norms prescribed by the competent Authority and contribute their share for approach road and such other common facilities. Here, I propose government provide facilities, utilities, and services in a generous way so that the same may be enjoyed by the inhabitants of the nearby areas taking in these facilities, utilities, and services.

(iv) The most difficult area, I think, is the area East of EM Bypass which is vulnerable for growth but where we certainly do not like to have high density development. Here also, I think, government may go for large scale land acquisition and distribution of the land, with restrictive covenants, among public agencies. Restrictive covenants would ensure that the vacant character of the land would be retained as far as feasible; public ownership, on the otherhand, would ensure that the land would be put to optimum economic use, and that land would be available for change of use if the next generation desires to do so for compelling reasons. From this point of view I suggest distribution of land from this strip among the agencies listed below :

(a) Department of Agriculture ;
(b) Deptt. of Animal Husbandary and Veterinary Services ;
(c) Deptt. of Fisheries ; and
(d) Deptt. of Cottage and Small Scale Industries.

If lands remain in public ownership we may reasonably hope that haphazard urbanisation will not involve the rural areas of the East and disturb agriculture and ecology both of which are essential for conservation of healthful urban life.

(v) For lands on the east of E. M. Bypass we strongly advocated intensive and extensive agriculture. Under the Integrated Rural Development Programme, and Special Employment Programme Government is already in action. To this if we can rope in the services of Welfare Organisations, I believe the result would be phenomenal. Here, our objective would be to identify training needs of the people and provide them with soft loan or even better livestock, seedlings and the like with which they would be able to augment their family income. □

LETTERS TO THE EDITOR

Preparation and use of oxalic acid-sodium thiosulphate-Schiff Reagent for Feulgen Staining: *In situ* absorption spectra

It was reported in an earlier publication that Schiff reagent can be prepared with citric, tartaric and oxalic acid, in place of N-HCl and the usual amount of potassium metabisulphite[1]. Of these, the dye-reagent prepared with critic and tartaric acid produced excellent staining of the nuclei following Feulgen hydrolysis. Schiff reagent prepared with oxalic acid and potassium metabisulphite did not produce powerful staining of the nuclei after acid hydrolysis of tissue sections. During the search of a suitable substitute for potassium metabisulphite, it was found that Schiff reagent prepared with N-HCl and sodium thiosulphate produced highly satisfactory staining of the nuclei in tissue sections which were hydrolysed in hydrochloric acid[2]. This communication presents a method in which oxalic acid has been used along with sodium thiosulphate to produce a dye-reagent with staining ability similar to that of citric or tartaric acid-Schiff reagents with increased shelf-life. The objective of the present investigation was to study the absorption properties of nuclei stained with the newly developed Schiff reagent, those of nuclei stained under UV rays as well as when stained under UV rays after removal of RNA.

Dye-reagent employing basic fuchsin of B.D.H., London, was prepared by dissolving 500 mg of the dye in 100 ml of warm distilled water. To this were added 500 mg of oxalic acid and 1.0 g of sodium thiosulphate, shaken thoroughly and then left in the refrigerator for 30 min. Afterwards, 1.0 g of activated charcoal was added to this dye-reagent. This was shaken vigorously for a minute and filtered. The filtrate appeared to be of pink colour and registered pH 4.0. This was kept in the refrigerator and within an hour the colour turned out to be very pale pink. After overnight storage in the refrigerator, the colour became almost colourless.

The tissues used in this investigation were liver, kidney and testis of a white rat that were fixed in 10% buffered neutral formalin. Paraffin sections (8 µm) were used. For staining, deparaffinised sections were hydrolysed in 6N HCl at 30°C for 15 min, rinsed with water and then stained with the newly-developed Schiff reagent at 25°C for 15 min, rinsed with water and treated with freshly prepared SO_2-water for 3-5 min, rinsed with water, dried between folds of filter paper, treated with n-butanol for 2-3 min, cleared in xylene and mounted in DPX. In some cases, staining was performed under UV rays obtained from the inner discharge tube of a 125 watt Philips mercury vapour lamp, keeping the sections 15 cm away from the UV source. Tissue sections from which RNA was extracted with conc. phosphoric acid at 5°C[3] and then subjected to hydrolysis in 6N-HCl at 30°C for 15 min were also stained with the newly developed Schiff reagent under UV rays.

The absorption spectra of nuclei stained with this modified Schiff reagent as well as those of nuclei stained under UV rays were recorded with a microspectrophotometer[4] at a magnification of X 750. Also, recorded were absorption data of nuclei stained for DNA-aldehydes after extraction of RNA followed by acid hydrolysis and staining with the modified Schiff reagent under exposure to UV rays. Each curve represents an average of five uncut tetraploid nuclei.

Result of staining acid hydrolysed tissue sections with the newly developed Schiff reagent was highly satisfactory. Within 4 min of staining, the nuclei started becoming red at 25°C. After 10 min, optimum colouration was possible. Sections were, however, stained for 15 min to ensure complete binding of the DNA-aldehydes with the dye molecules. Staining of the acid-hydrolysed tissue sections under UV rays for 5 min yielded much more intense nuclear colouration than was possible in the control. This is evident in the absorption curves of nuclei stained under the two different conditions. On the basis of Beer-Lambert law, the curve height of UV treated nuclei was more than that of nuclei stained under the laboratory conditions (Fig. 1).

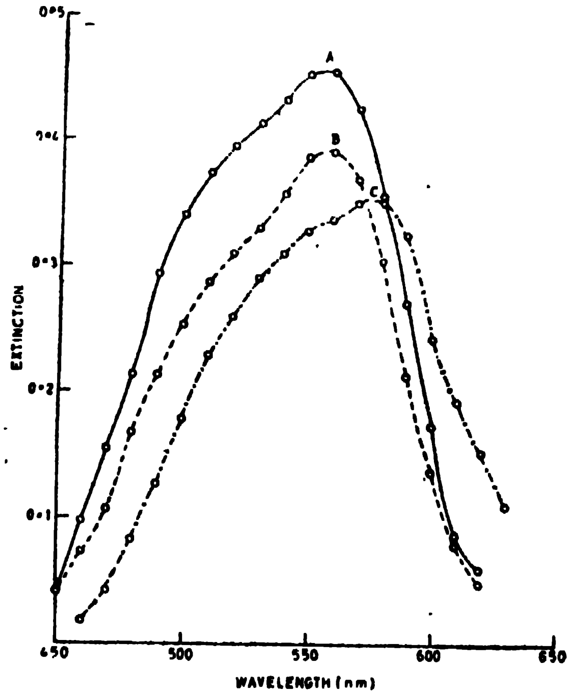

Fig. 1. *In situ* absorption spectra of nuclei stained with (A) Schiff reagent under UV rays (B) Schiff reagent after extraction of RNA followed by acid hydrolysis under UV rays and (C) Schiff reagent after acid hydrolysis.

The absorption spectra of nuclei stained under the laboratory conditions as well as those of nuclei stained under UV rays reveal bell-shaped nature of the curves. The peak of maximum absorption in the former case is at 570-580 nm and in the latter case at 550-560 nm. Sections of tissues after extraction of RNA with cold phosphoric acid followed by acid-hydrolysis and staining under UV rays reveal peak-absorption at 550-560 nm (Fig. 1).

The shelf-life of the newly-developed Schiff reagent is atleast three months. During this period, there was no impairment of Feulgen staining intensity of the nuclei. The above results indicate that under appropriate conditions, oxalic acid can be used with success in the preparation of Schiff reagent. Regarding increase in the staining intensity of nuclei when acid hydrolysed tissue sections are stained under UV rays, it may be mentioned that augmentation of nuclear colouration is also possible when staining is carried out with an aqueous solution of basic fuchsin. Therefore, it can be concluded that UV rays facilitate the regeneration of basic fuchsin through electronic excitation from the colourless Schiff reagent which then reacts with the DNA-aldehyde molecules liberated through acid hydrolysis. This interpretation may be true since after exposure to UV rays, the colourless Schiff reagent turns out to be of deep violet colour within a few minutes. The absorption properties of this deep violet colour reagent indicate a peak of maximum absorption at 550 nm which is also the position of the peak-absorption of an aqueous solution of basic fuchsin[3]. Moreover, the peak-absorption of nuclei stained under UV rays is at 550-560 nm and that of nuclei stained with Schiff reagent under laboratory conditions at 570-580 nm, as presented in this communication. Not only this, the peak of maximum absorption of nuclei stained with an aqueous solution of basic fuchsin after acid hydrolysis of tissue sections is at 560 nm [4,5] and that of nuclei stained with Schiff reagent at 570 nm[6,7]. The above interpretation receives further support from the fact that the peak of maximum absorption of nuclei in tissues from which RNA has been extracted, then hydrolysed in hydrochloric acid and stained with an aqueous solution of basic fuchsin[8] at 560 nm and such is also the case as revealed in the present investigation when similarly-treated tissue sections are hydrolysed in hydrochloric acid and then stained with Schiff reagent under exposure to UV rays, revealing peak-absorption of stained nuclei at 550-560 nm.

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Colour reactions of liquid organic compounds with two newly-developed decolourised basic Fuchsin dye-reagents

Aqueous solutions of some basic dyes can be decolourised with N-H_2SO_4 and sodium sulphide (Na_2S, $2H_2O$)[1, 2]. This communication presents two other methods to decolourise aqueous solutions of basic fuchsin which are shaken with activated charcoal and filtered. The filtrates are totally colourless in both cases and there are useful in the detection of some liquid organic compounds.

The dye-reagents employing basic fuchsin (E. Merck) were prepared as follows :

Reagent A : To 100 ml of a 0.1% aqueous solution of the dye was added 10 ml of a 25% phosphoric acid and mixed well. This was shaken vigorously with 1.0 g of activated charcoal and filtered. The filtrate appeared to be very pale pink. This reagent was further shaken with 1.0 g of activated charcoal and filtered again. The filtrate now appeared to be totally colourless and it registered pH 1.9.

Reagent B : To 100 ml of a 0.1% aqueous solution of basic fuchsin was added 20 ml of conc. H_2SO_4 and this was shaken vigorously with 1.0 g of activated charcoal and filtered. The filtrate was pale yellow in colour and it registered pH 0.9.

The different organic compounds tested to give positive or negative result, on being mixed and shaken with the newly developed dye reagents, are listed in Table 1. Since the present dye-reagents reacted with solvent ether, solid organic compounds could not be dissolved in this liquid. Chloroform, when shaken with the dye-reagents prepared with H_3PO_4 and H_2SO_4, did not exhibit any colour reaction and, therefore solid organic compounds were dissolved in this solvent. However, resorcinol, quinol, p-hydroxy benzaldehyde and phthalic acid did not get dissolved in chloroform and hence these four solid compounds could not be tested. The other solid compounds, such as vanillin, veratraldehyde, benzophenone and phenylacetic acid are soluble in chloroform but the results are negative. The colours in all other cases has been included in the same table.

From Table 1, it is apparent that the present dye-reagents are highly suitable for the detection of most of the liquid organic compounds except acetaldehyde. Unsaturated acids, such as linoleic and formic gave positive reaction with the dye-reagent prepared with H_2SO_4 but negarive result was obtained with the one prepared with H_3PO_4. None of the two steroid hormones, viz. testosterone propionate and deoxycorticosterone produced any colour reaction. Both the dye-reagents did not produce any colour reaction with tap or distilled water. The pH of the dye-reagents is quite low, being 1.9 and 0.9. Since increase in the pH of these reagents brought about by tap or distilled water did not produce any colouration, the obvious conclusion may be that colour production is due to chemical reaction. With 0.1 N-NaOH both the dye-reagents produced uniform magenta colour. Since in the case of several liquid organic compounds, two layers, one coloured and the other colourless are formed, the above interpretation that colour reaction with the compounds may be due to chemical reaction seems cogent.

It is necessary to point out here that

TABLE 1 : Reaction of liquid organic compounds with newly-developed dye-reagents.

Compound	Reagent A	Reagent B
I. Alcohols		
(a) Methanol	+ve (pink)	+ve (blue)
(b) Ethanol	+ve (pink)	+ve (blue)
(c) n-Propanol	+ve (pale pink)	+ve (blue)
(d) n-Butanol	+ve (upper pale pink ; lower colourless)	+ve (upper blue ; lower pale yellow)
(e) iso-Butanol	+ve („)	+ve („)
(f) tert-Butanol	+ve (pale pink)	+ve (blue)
(g) n-Pentanol	+ve (upper pale pink ; lower colourless)	+ve (extremely pale blue)
II. Aldehydes		
(a) Formaldehyde	+ve (deep magenta)	+ve (magenta)
(b) Acetaldehyde	−ve	−ve
(c) Glutaraldehyde	+ve (pale pink)	+ve (clowdy, colourless)
(d) Paraldehyde	+ve (upper pale pink ; lower colourless)	+ve (upper colourless ; lower pale yellow)
III. Ketone		
(a) Acetone	+ve (pink)	+ve (sky-blue)
IV. Carboxylic acids		
(a) Acetic acid	+ve (pale pink)	+ve (extremely pale green)
(b) Formic acid	−ve	+ve (deep yellow)
(c) Linoleic acid	−ve	+ve (clowdy, colourless)
(d) Oleic acid	+ve (clowdy, colourless)	+ve („)
V. Amines		
(a) Tributylamine	+ve (upper colourless ; lower deep pink)	+ve (violet ring)
(b) Dimethylaniline	+ve (upper straw ; lower deep pink)	+ve (upper pale orange ; then violet ring ; lower pale green)
(c) Pyridine	+ve (deep magenta)	+ve (magenta)

these colourless dye-reagents do not get changed to a magenta colour on being exposed to UV rays and, therefore, these reagents cannot be compared with Schiff reagent which gets changed to a deep magenta colour when similarly treated. Nor can these reagents be used in Feulgen procedure. The shelf-life of both the dye-reagents is atleast 24 h. However, for ensuring perfect reaction, freshly prepared reagents should be used.

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Inhibitory effect of fertilizer nitrogen on the growth of *Azolla pinnata*

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Azolla is a waterfern in which nitrogen-fixing blue-green alga *Anabaena azollae* fixes atmospheric nitrogen and the aquatic fern multiplies very rapidly. *Azolla* is widely used as a potential green manure and dual crop with rice for increasing the grain yield of rice[3]. The positive rice crop response to *Azolla* biofertilizer inoculation was well documented[4]. Govindarajan *et al*[2]. reported that inoculation of *Azolla* at 300 g/m^2 as dual crop with rice and incorporation of *Azolla* twice have shown significant increase in grain yield of rice which was equivalent to that of 25 kg fertilizer nitrogen per hectare. *Azolla* plants are sensitive to the presence of high concentrations of nutrients. The macronutrients such as P, K, Ca, Mg and micronutrients such as Fe, Mo, Co have been shown to be essential for the growth and nitrogen fixation of *Azolla*[5]. For nitrogen, the *Azolla-Anabaena* system can rely upon the supply of nitrogen in the air and combined N is, however, also assimilated at low concentrations by the roots while the N_2 in the atmosphere is assimilated by the leaves. The present paper deals with the effect of fertilizer nitrogen (Urea) on the growth of *Azolla* and the results are reported.

Cement pots of the size 1×0.6 m were selected and 5 kg of rice field soil was added and maintained flooded condition with a water level of 10 cm. Nitrogen levels at 20, 40, 60, 80, 100 and 120 kg/ha basis were calculated and applied. *Azolla* was inoculated at 200 g/pot and furadan at 1 g/pot was applied to control insect pests of *Azolla*. Fresh weights of *Azolla* biomass were taken on 10th day.

All the levels of fertilizer nitrogen (Urea) have recorded significant reduction in the growth of *Azolla*. Increase in the levels of fertilizer nitrogen has proportionately decreased the growth of *Azolla* (Table 1). Among the different levels of fertilizer, nitrogen 100 and 120 kg/ha have markedly inhibited the growth. The results have clearly pointed out that the fertilizer nitrogen has been found inhibitory on the growth of *Azolla*. Becking[1] found that the addition of combined nitrogen reduced the fresh weight production of *Azolla* to 34% and total N content of 43% over control. The *Azolla-Anabaena* association retained significant nitrogenase activity when the fronds were grown in nitrate of Urea[6]. The present results clearly revealed that the application of urea suppressed the growth of *Azolla* indicating the inhibitory effect of Urea.

TABLE 1: Effect of fertilizer nitrogen (urea) on the growth of *Azolla*

Nitrogen (kg/ha)	Mean Azolla weight (g)	% decrease over control
Control	290.00	—
20	251.67	(–) 13.22
40	228.33	(–) 21.27
60	176.67	(–) 39.09
80	161.67	(–) 44.26
100	155.00	(–) 46.56
120	113.33	(–) 60.93

C.D.: 28.10

Significant at 1% level

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Influence of inoculum potential on the growth of *Azolla*

Azolla is a waterfern that fixes atmospheric nitrogen in association with the nitrogen-fixing blue-green alga *Anabaena Azollae*. Biological nitrogen fixation through *Azolla-Anabaena* complex is considered to be a potential biological system for increasing rice yield at a comparatively low cost. Interest in the *Azolla Anabaena* association in relation to tropical rice production is primarily based on the ability of the association to fix nitrogen and thus enriching the nitrogen status of the soil. *Azolla* is extensively used as a green manure in Vietnam and China[4, 7]. The utility value of *Azolla* for rice production in India was reviewed by Kannaiyan[3] and Singh[6]. Watanabe *et al*[8]. established the potential ability of *Azolla* nitrogen fixation around 1.1 kg N/ha per day. Singh[6] reported that a layer of *Azolla* covering a hectare of rice field contains about 10 t green matter and ensures about 25-30 kg N/ha. *Azolla* can be used effectively as dual cropping with rice to supply nutrients after the formation of a mat either by decomposition after overgrowth or by incorporation into the soil.[3] In the present study, an attempt has been made to study the optimum dose of inoculum needed for inoculation under field condition.

A field experiment was conducted in randomised blocks design with four replications during *Samba* season, 1982. Phosphorus at 15 kg/ha level was applied basally. Water level was maintained at 10 cm. The plot size of the experiment was 3 × 2 m. Fresh healthy plants of *Azolla pinnata* was collected and completely drained the water and used for inoculation. *Azolla* was inoculated to the plots at 25, 50, 100, 150, 200, 250, 300, 350, 400, 450, 500 and 550 g/m^2. Furadan at 1 g/m^2 was applied to control insect pests of *Azolla*. *Azolla* was allowed to grow for 20 days and fresh weight of *Azolla* was recorded.

TABLE 1 : Influence of inoculum potential the growth of *A. pinnata* (20 days)

Azolla inoculum level/m^2(g)	*Azolla* growth (kg/plot, 3 × 2 m)	Relative growth rate (RGR) (g/g/day)
25	0.3	0.008
50	1.2	0.036
100	2.0	0.017
150	3.8	0.053
200	7.6	0.092
250	8.1	0·094
300	9.8	0.103
350	10.0	0.103
400	10.6	0.105
450	11.0	0.105
500	12.5	0.112
550	12.2	0.109

C.D. = 2.364
(C.D. : P = 0.01)

The growth rate of *Azolla* was poor at lower inoculum level (Table 1). Increase in inoculum level correspondingly increased the growth of *Azolla*. The threshold level of *Azolla* inoculum for better growth and multiplication was 200 g/m^2 under field condition. There was not much difference in the relative growth rate from 200 g/m^2 and at higher inoculum level. Inoculation of *Azolla* at 200 g/m^2 under field conditions is more optimum and economical also. Many workers have used 300 g/m^2 of *Azolla* for inoculation under field conditions[1,5-6]. The present results clearly show that 200 g/m^2 would suffice for better growth and multiplication of *Azolla* under field conditions. Hence, the fresh *Azolla* inoculum required per hectare of rice field is only 2 t and this has got agronomical significance.

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Moderately susceptible rice varieties as an index to monitor gall midge populations at different plant age in field

One of the major constraints to achieving the yield potentials of modern rice varieties in India is their susceptibility to gall midge. *Orseolia oryzae* (Wood-Mason).

TABLE 1 : Incidence of gall midge on moderately susceptible, rice varieties at different ages of the plant

Weeks after transplanting	Variety[a]						
	Karuna	Vaigai	T(N)1	Jaya	Chitraikar	IET 6759	Mean
1	0.0 (1.81)*	0.0 (1.81)	3.8 (11.20)	0.0 (1.81)	0.0 (1.81)	0.0 (1.81)	(3.37)
2	13.9 (21.89)	11.7 (20.00)	14.8 (22.69)	7.1 (15.44)	10.2 (18.61)	7.0 (15.35)	(19.00)
3	1.5 (7.12)	4.2 (11.73)	12.2 (20.41)	7.3 (15.60)	0.0 (1.81)	1.4 (6.78)	(10.56)
4	1.8 (7.78)	10.6 (19.07)	11.9 (20.19)	7.6 (16.04)	6.9 (15.27)	13.2 (21.34)	(16.61)
5	2.9 (9.82)	2.9 (9.82)	2.8 (9.65)	0.0 (1.81)	2.5 (9.11)	9.4 (17.81)	(9.64)
6	16.5 (23.93)	21.1 (27.36)	16.5 (23.93)	19.3 (26.05)	15.2 (22.90)	20.4 (26.88)	(75.52)
Mean	6.1 (12.05)	8.4 (14.95)	10.3 (10.30)	6.88 (12.79)	5.8 (11.58)	8.5 (14.99)	

Level of Significance		*C.D. (P = 0.05)*	*Conclusion*
Between periods	0.01	10.38	$\overline{P_1 \quad \underline{P_2 \quad P_3}} \underline{\quad P_4 \quad P_5} \quad P_6$
Between varieties	N.S.		

[a] Mean of 3 replications
* Arc sinc transformation

During the main season 1981, at Madurai, India, gall formation on 6 moderately susceptible rice varieties (MSRV) replicated three times in 10 – m^2 plots, was recorded at weekly intervals after transplanting for a period of six weeks.

The results revealed that galls are noticed as early as the second week after transplanting (WAT) (Table 1), indicating that the infestation is carried over from the ratoon, which are known to harbour hibernating larvae of gall midge during off-season. Among varieties, the incidence of gall midge was fairly uniform. The number of galls was significantly higher at six WAT. This could be due to the emergence of second generation adults, because the developmental period from egg to adult is about 25-30 days. This shows that the first generation adults would have laid eggs on 2 weeks old plants.

The present findings can be of use for timing insecticide applications and light-trap installations, to keep the pest populations below economic injury levels during the later stage of the rice growing season. The MSRV can thus form an important component for IPC of gall midge.

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Problem of stability of a cell

The mathematical theory of cell division has been studied[1-5]. The relations between cellular growth (i.e. protein and RNA synthesis) and the nuclear division cycle have been described[6-7]. The cell expands to a critical size, then divides before growth can continue and the cycle is repeated. After i cell divisions 2^i cells are obtained from the cell originally present. The rate of division or the cell-cycle is very sensitive to changes in the cellular environment. It depends on [1,3] temperature, surface tension, viscosity and the vibrational frequency of the cell. Viscosity, of course, will always tend to prevent it from dividing.

During the expansion a pulsating cell, the contents of the cell would do work on the body fluid of the cellular environment. In a compression, the pressure field in the body fluid would do the same amount of work on the cell. So there is no-net transfer of energy during a cycle of the motion of a pulsating cell. To perform work, the cell reacts ATP with the particular "working system" in such a way that high energy bonds are split and the working system is activated[8]. The sequence of energy transformations have been discussed[8].

We consider the wall of a spherical membrane under an internal pressure, p. The wall stress, σ is given by

$$\sigma = \frac{pR}{2h}, \qquad (1)$$

where R is the initial radius and h is the thickness of the membrane.

As R increases, the membrane becomes thinner, its area increases but its volume is hardly changed. The protein layer of the membrane has rubber-like elasticity whereas the lipid layer behaves as a two-dimensional fluid[9]. (The coefficient of rigidity or shear moduli of all protein gels are found to be in the range of [10] $10^2 - 10^4\ Nm^{-2}$). Thus, we write

$$h \,.\, 4\pi R^2 = V, \qquad (2)$$

V=volume of the wall of the membrane. Therefore, we have

$$\_\_2\pi p R^3 \qquad (3)$$

The strain in the membrane is given by

$$\underline{e} = \frac{R - R_0}{R_0}, \qquad (4)$$

where R_0 is the initial reference radius. The work done per unit volume of the membrane is ½×stress×strain, where the stress and strain are defined above.

With the increase of radius (increasing distensibility), the stress in the wall increases and ultimately reaches the rupture stress.

Heat conduction tends to decrease the temperature and average pressure within the cell. It tends to increase the rate of cell division and hence the kinetic energy of the surrounding fluid. It also tends to increase the collapse speed of the vacuole in a plant cell. Changes in cellular environment is reflected in physiological processes[11-12].

In its growth, the cell does not maintain a spherical size. The behaviour shows that the surface of a cell being accelerated outwards is unstable and may break. (The acceleration is directed from cell into the body fluid). If the acceleration of the interface continues to increase, the pressure in the body fluid will increase. The cell expands to a critical size until its inward motion is finally arrested by an increase of cell pressure. It is shown[1,3] that the vibrational frequency, ω of a cell is directly related to its size and volume ; these are again directly proportional to the protein content of the cell.[13] This shows that as the frequency is varied the maximum relative volume to which a cell will grow varies (the capacity of a cell of individual species to grow is limited). The capacity of cells to grow is in the sense of adding to their content of chemical substances[14]. A cell can only double its mass[14]. The cell values must be double the initial values[11]. Prior to the division of the nucleus, the amount of DNA doubles and during division, this amount is precisely halved[15].

During the cycle, the rate of growth (of mass, m) of a cell is given by[3]

$$\frac{dm}{dt} = \alpha m, \qquad (5)$$

where α is a constant which is a function of cellular constituents and environmental conditions. The equations suggests that

$$\alpha = \log_e 2/T, \tag{6}$$

where T is the time of doubling.

If τ_1 be the time for chromosome replication and τ_2 be that for septum formation, we can write for the cell volume[16, 5]

$$V = V_0 2\,(\tau_1 + \tau_2)/\tau, \tag{7}$$

where t is the generation time of the cell and V_0 is the reference volume. The faster the growth, the larger the cell volume[16].

Let R and $R+\delta R$ be respectively the radii of a cell at two different stages of growth (assumed to be spherical) and K be a ratio of the maximum amount of oxygen obtainable to the oxygen required. For a cell to survive, we have $K > 1$ (young cell) and let $K = 1+\gamma$, $\gamma > 0$ (but is assumed to be small). Let K^1 denote the same factor for an older cell, where $K^1 = 1+\gamma^1$, $\gamma^1 > \gamma$. If we define

$$K^1/K = R/(R + \delta\,R) \tag{8}$$

and if $\gamma^1 \rightarrow 0$, we have $\delta R \rightarrow \gamma \overset{*}{R}$. The critical radius is

$$\overset{*}{R} = R\,(1+\gamma), \tag{9}$$

which is a condition of unstable equilibrium. The cell then becomes distorted and is assumed to be cylindrical before division. We find here that the growth of a cell resulting oxygen deprivation leads to physical (shape) instability. In the case of a young cell, surface area/volume ratio is $3/R$ whereas that for an older cell is $\dfrac{3}{R\,(1+\gamma)}$. A young cell has a relatively large surface area for metabolic exchanges.

The surface instability serves as a limitation on the pressures and temperature within the cell which is a function of environmental conditions. If a stable cell pulsates in a body fluid, a relatively small increase in pressure will make it unstable. The radial motion itself of a cell is unstable and the cell would pulsate with increasing amplitude. It expands until it approaches a critical size and the cell then would tend to divide. There is also a critical amplitude at which the cells become unstable. It can be shown [1-2, 10] that in a linear motion, the cell would become unstable at a frequency, ω and its amplitude of oscillation would increase linearly with time. At this stage, the cell expands to a critical size and at a frequency $\omega = \omega_0$, the cell divides into two daughter cells. In a non-linear motion, a cell may become unstable for the combination of ω and the pressure amplitude generated which is a function of cellular constituents and environments.

The cytoplasmic boundary as well as the small vacuoles present inside a plant cell vibrate with the oscillatory activity of the nucleus. Nucleus actively synthesizes RNA and that nuclear RNA is transferred to the cytoplasm[17]. The presence of RNA is to be expected in cells engaged in active protein synthesis, and it is now known that chromosomes in interphase and in early and mid-prophase are involved in RNA synthesis[18].

Vacuoles are fluid-filled membrane enclosed spaces within the cytoplasm[19]. They force the cytoplasm to the outside of the cell, where a ready exchange of certain materials can occur. They also serve to maintain the proper internal pressure in cells. The theory of coalescence of the vacuoles on the basis of wave motion has recently been studied[1]. It can be shown mathematically that the resultant vacuole is a position of unstable equilibrium and tends to vanish after coalescence.

We choose spherical coordinate system with the origin at the centre of a vacuole which is initially at rest in a cytoplasmic fluid. The pressure of this fluid is a function of time during the cell cycle. The vacuoles start to move in such a way that the motion of the surrounding cytoplasm is spherically symmetric. Assuming the fluid to be incompressible and following Noltingk and Neppiras[20], the motion of the interface can be written as

$$\frac{du}{dt} + \frac{3}{2}\,\frac{u^2}{R} = \frac{1}{\varphi(t)\,R}\left\{ p(t) - p^{E}(t) \right\}, \tag{10}$$

where u is the speed of the interface, R is its radius, $p(t)$ is the pressure in the fluid at the interface. $p^1(t)$ is the pressure of the cytoplasm away from the interface and $\bar{\rho}(t)$ is its density. (In the radical motion of an incompressible fluid, viscosity does not come into the equation of motion, but appears in the boundary conditions).

For our analysis, if we assume that the pressure of the cytoplasm is constant, i.e. $p = p_0$, $p^1 = p_e$ and $\varphi(t) = \varphi$, the equilibrium density of the fluid, we can write[24]

$$u^2 = \frac{2}{3} \quad \frac{p_e - p_c}{\varphi} \left\{ \left(\frac{R_{ni}}{R} \right)^3 - 1 \right\}, \quad (11)$$

$$i = 1, 2, 3, \ldots \ldots, (v_e > p_c)$$

R_{ni} is the initial radius.

The motion of the vacuole will create a pressure field inside the cell. If the speed of the vacuole interface changes slowly, a disturbance will be transmitted from the vacuole to a nearby point in the cell fluid. If the vacuoles were at rest in a cytoplasmic fluid, surface tension would quickly cause them to dissolve. A (weak) shock wave will be generated inside the cell when the resultant vacuole just disappears. The pressure falls off with the distance. The shock can influence the growth pattern of a plant cell. As the vacuole disappears, the cell fluid does work on the contents of the vacuole[4]. The pressure inside the cell is maximum, the stress on the wall increases, a plant cell loses its stability and tends to divide.

The dynamic interaction of nucleoplasm with chromosome has recently been studied[22]. The volume of a nucleus is found to be a function of the number of chromosomes for a particular cell[17]. During the cell-cycle, the chromosomal material first begins to contract and thicken and becomes much thicker as replication occurs[23]. Initially, the length of a chromosome can be expressed as

$$l_c = f(n_g) + H, \quad (12)$$

where n_g is the number of genes it contains and H is a constant factor for a chromosome of a particular cell. The size of a chromosome is also a function of the environmental conditions.

We shall now discuss the physical processes of chromosome condensation in terms of internal chromosomal stresses. Chromosomes are compressed by stresses acting at both ends. Due to this stress, they shorten in the direction of the stress. This shortening, of course, will give an increase in energy. As long as the chromosome maintains its original shape, there is no energy due to shortening. As the stress is increased, chromosomes begin to contract and various shape patterns occur. The stress at which the change from the original to the thicker stage occurs may be called the critical stress of the chromosomes. At this stage, the stress on the membrane boundary of the nucleus tends to reach the rupture stress and the nucleolus disappears. As the energy is slightly increased, chromosomes break and the two chromatids of each chromosome separate, which are now termed as chromosomes. The nucleus then divides into two. Quantitative changes in DNA during mitosis have been related to stages of chromosome division[24]. The cell division is initiated by the division of the nuclear material[25]. The time taken for the cycle varies, the minimum being about 10 h.[26].

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Nutrient drain by weeds in jute corp

During jute-growing season in eastern India, a luxuriant weed vegetation prevails due to incidence of profuse rains and optimum humidity and temperature. In the absence of timely weeding or if weeding is incomplete, the fibre yield (which is highly correlated with vegetative growth of the crop) is drastically curtailed. Chakraborty[1] estimated the loss to be 63% for *olitorius* and 52% for *capsularis* jute by weed infestation.

Since weeds have the same requirements for growth as crop plants, a good deal of fertilisers applied to the soil during cultivation is taken up by the weeds. Experiments were conducted to find out the competition for nutrients between jute crops and weeds (Table 1). P, N and K were determined following methods adopted by Horwitz[2], microkjeldahl technique of Jackson[3] and procedure of Piper[4] respectively.

In Tripura, the *olitorius* crop is cultivated in highland (*tilla*) and the *capsularius* in medium highland. But weed intensity is higher in highland and lower in medium highland, with more nutrients being used up by weeds in the former than in the latter. While the broad-leaved weed *Borreria articularis* (L. f.) F. N. Will is the predominating element in highland, the narrow-leaved sedge *Cyperus compressus* L. dominates in medium highland[5]. Huge amounts of N and P are drained out by *B. articularis* in contrast to *C. compressus* where the loss is not so substantial (Table 1).

The foregoing will point out the need for effective control measures which will undoubtedly improve the nutrient status of

TABLE 1 : Uptake of nutrients by weeds and jute crop

Test plants	Quantum of nutrients (kg/ha)		
	N	P_2O_5	K_2O
Corchorus olitorius JRO 632	26.81	15.10	60.88
Weeds associated with *olitorius* jute	85.40	46.22	73.77
Borreria articularis	66.17	40.92	55.17
C. capsularis JRC 212	27.56	18.98	72.27
Weeds associated with *capsularis* jute	29.07	8.25	39.89
Cyperus compressus	12.96	1.59	10.94

jute plants and thereby augment fibre yield.

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Preparation of crystal violet-SO_2 with different acids and potassium metabisulphite and their use in Feulgen procedure

Not all organic acids can replace hydrochloric in the preparation of crystal violet dye-reagent. For example, citric acid in combination with potassium metabisulphite, produce a reagent that does not serve the purpose of staining DNA-aldehyde molecules in acid-hydrolysed sections of mammalian tissue sections fixed in different fixatives. In search of organic acids, other than citric, it was found that ascorbic, oxalic, trichloracetic acid (TCA) and benzoic acid are quite suitable. Hydrochloric acid, among mineral acids, has been used by the present author to prepare crystal violet dye-reagent[1]. This report presents the effective use of N-H_2SO_4, along with potassium metabisulphite, for the same purpose. Below is a brief description of the use of these five acids along with potassium metabisulphite for the preparation of dye-reagents employing with dye for the staining of nuclei in mammalian tissues fixed in different fixatives.

Crystal violet (E. Merck, C.I. No. 42555) is one of the aminotriarylmethane group of dyes. Dye-reagents were prepared by dissolving 500 mg of the dye in five separate lots of 100 ml of warm distilled water. To one of these was added 10 ml. of N-H_2SO_4, to the second lot 500 mg of ascorbic acid, to the third, fourth and fifth lots, an equivalent amount of TCA, oxalic and benzoic acid respectively. Each of these five reagents also contained 1.0 g of potassium metabisulphite. After thorough mixing, these were filtered. The filtrates of each were of rather pale violet colour which after storage in the refrigerator were reduced to an extremely pale green colour in the case of TCA, H_2SO_4 and benzoic acid dye-reagents, registering pH 2.8, 4.1 and 4.3 respectively. Oxalic and ascorbic acid dye-reagents were reduced to green and extremely pale violet colour pH 2.7 and 4.0, respectively. All these reagents became blue or pale violet in colour when exposed at 20°C.

Pieces of liver, kidney, ovary and intestine of a white rat that were fixed in 10% neutral formalin, Flemming and Dutt's modification of Nawaschin mixture[2] were used in this investigation. Paraffin sections (8 μm) were used.

Staining was performed after deparaffinisation of the sections followed by Feulgen hydrolysis. UV rays were administered for 10 min during staining. The control sections which were not exposed to these rays were also run simultaneously. Following staining sections were treated with 0.05 N-HCl for 15 sec to a min, rinsed with water, dried between folds of filter paper, treated with n-butanol or iso-propanol in different cases for 15 sec to 3 min in differently fixed materials, cleared in xylene and mounted in DPX. In some cases, staining of tissues in the three different fixatives was also performed with 0.5% aqueous solution of the dye.

Microscopic examination of sections of tissues fixed in the three different fixatives when stained with crystal violet dye-reagents or with an aqueous solution of the dye revealed excellent and specific nuclear colouration. Staining with the dye-reagents under UV rays revealed a far more intense colouration of the nuclei than in the controls in which colouration was extremely feeble. Formalin-fixed tissues when stained with the dye-reagents under UV rays could be treated with 0.05 N-HCl. On the contrary, sections of tissues fixed in Flemming and Dutt's Nawaschin mixture, when stained with the dye-reagents or with an aqueous solution of the dye did not withstand treatment in the acid water. In all these cases, stained preparations were dried between folds of filter paper, treated with n-butanol or iso-propanol for varying time-periods, cleared in xylene and mounted, revealing excellent and specific nuclear colouration In no case was it possible to dehydrate sections after staining through ethanol grades, since following the procedure stain from the nuclei leached out completely.

In view of the fact that crystal violet dye is soluble in n-butanol or iso-propanol and the compound formed from the dye molecule and DNA is not, the conclusion is that an insoluble dye-DNA-aldehyde complex is formed. Since following staining of sections of tissues fixed in the different fixatives is possible with the dye-reagents under UV rays as well as with an aqueous solution of the dye and preparations stained following these two procedures behave similarly, it is apparent that the mechanism of staining in the two cases is similar. Moreover, staining with the dye-reagents is also possible in the controls, although the intensity of nuclear colouration is extremely feeble despite the fact that the dye-reagents get oxidised revealing violet colouration. Oxidation of the dye-reagents is also possible at elevated temparature (40°C), but a specific nuclear colouration is not possible at this temperature. Not only this, sections of tissues fixed in the different fixatives when stained with an aqueous solution of the dye, did not tolerate treatment in 0.05 N-HCl. Under the circumstances, it may be reasonable to infer that under UV rays,

be reasonable to infer that under UV rays,

regeneration of the dye molecules from the more or less colourless dye-reagents takes place. These UV-treated violet dye-reagents are responsible for the dye molecules to get bound with the DNA-aldehyde molecules and, therefore, the mechanism of staining with the dye-reagents under UV rays can be considered to be of Feulgen type. What UV rays do is not merely to produce reagents like an aqueous solution of the dye but it also excites the dye molecules electronically[1,3] which then bind with DNA producing a specific nuclear colouration In the case of staining with an aqueous solution of the dye, it may be possible that condensation of the tertiary amino group of the dye molecule with DNA-aldehyde molecules takes place producing a specific colouration of the nuclei.

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Ascorbic-acid content in different varieties of guava grown in West Bengal

Guava, the apple of the tropics, is considered as a rich source of ascorbic acid. According to Phandis[3], guava contain 260 mg vitamin-C per 100 g of fruit pulp. Variations in ascorbic acid content in different varieties[1,2,5] and season of fruit growth[4,6] were reported. In the present investigation, the ascorbic-acid content of eleven guava varieties were studied in both rainy and winter season under the agro-climatic condition in the alluvial plains of West Bengal.

Fruit samples of guava cultivars Allahabad Safeda, Apple colour Banarasi,

TABLE 1 : Vitamin-C content of different guava varieties

Variety	(Vitamin-C (mg/100 g of pulp)	
	Rainy	Winter
Allahabad Safeda	106.0	187.9
Apple Color	116.2	194.6
Banarasi	93.0	172.6
Baruipur	103.9	182.2
Behat Coconut	88.8	168.0
Chittidar	96.4	182.8
Harijha	92.3	164.6
Lucknow-49	132.5	216.0
Pear Shaped	75.2	157.4
Red Fleshed	62.5	144.6
Seedless	83.3	168.2

Baruipur, Behat coconut, Chittidar, Harijha, Lucknow-49, Pear Shaped, Red Fleshed and Seedless were collected from the six experimental trees of optimum maturity under each cultivar. The fruit juice was squeezed out by means of a electrical juice extractor which was filtered and the vitamin-C content of fruits was estimated by standard procedure[7].

The vitamin-C content of fruits showed wide variation among the varieties and between the seasons. The fruits of Lucknow-49 contained 216.0 mg vitamin-C per 100 g of pulp, while in Red Fleshed it was only 144.6 mg/100 g of pulp in winter. All the varieties contained comparatively greater amount of vitamin-C during winter as compared to those in rainy season and the percentage increase varied between 63 to 131 depending on the variety. In general, fruits of Banarasi, Behat Coconut, Chittidar, Harijha, Pear Shaped, Red Fleshed and Seedless contained lesser amount of Vitamin-C compared to other varieties, in both the seasons (Table 1).

In the present investigation, all the varieties were raised by vegetative propagation and the study was also undertaken in the same agro-climatic condition ; hence, the variation is considered due to varietal characters. The findings appear to be in confirmity with the findings of Sachan and Ram[3] and Teaotia *et al*[5].

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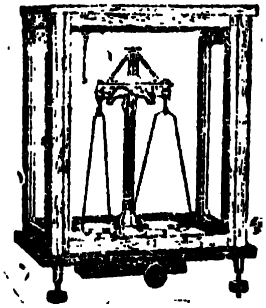

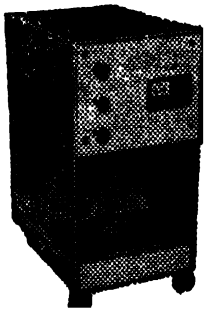

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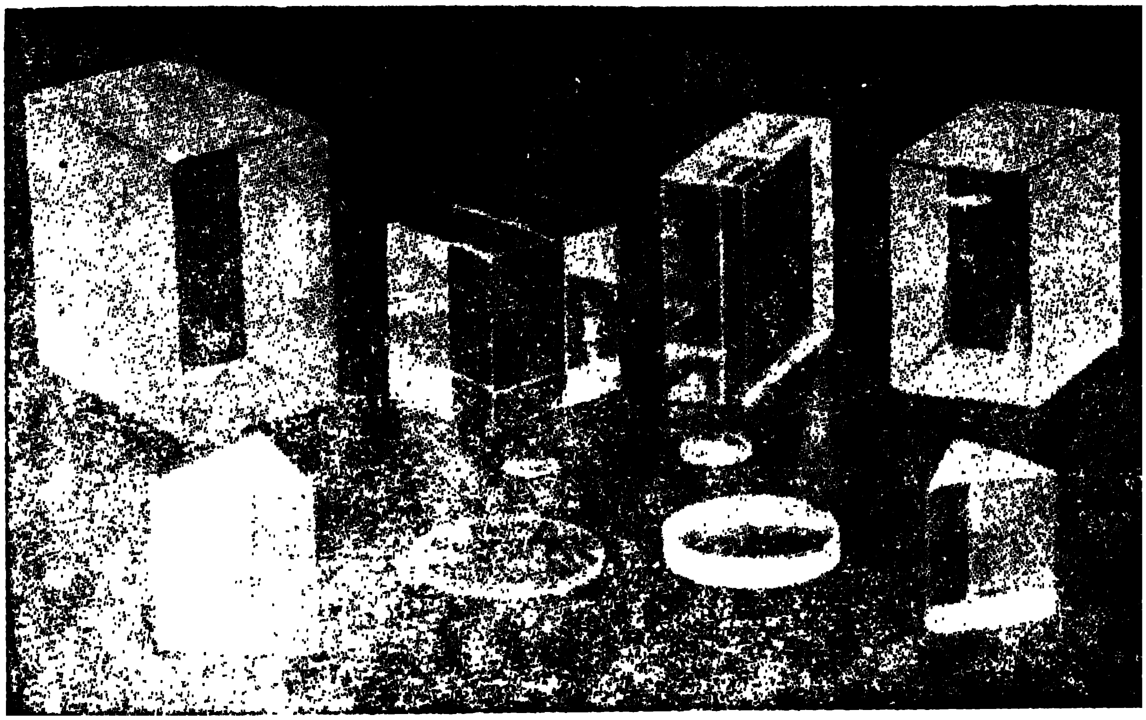

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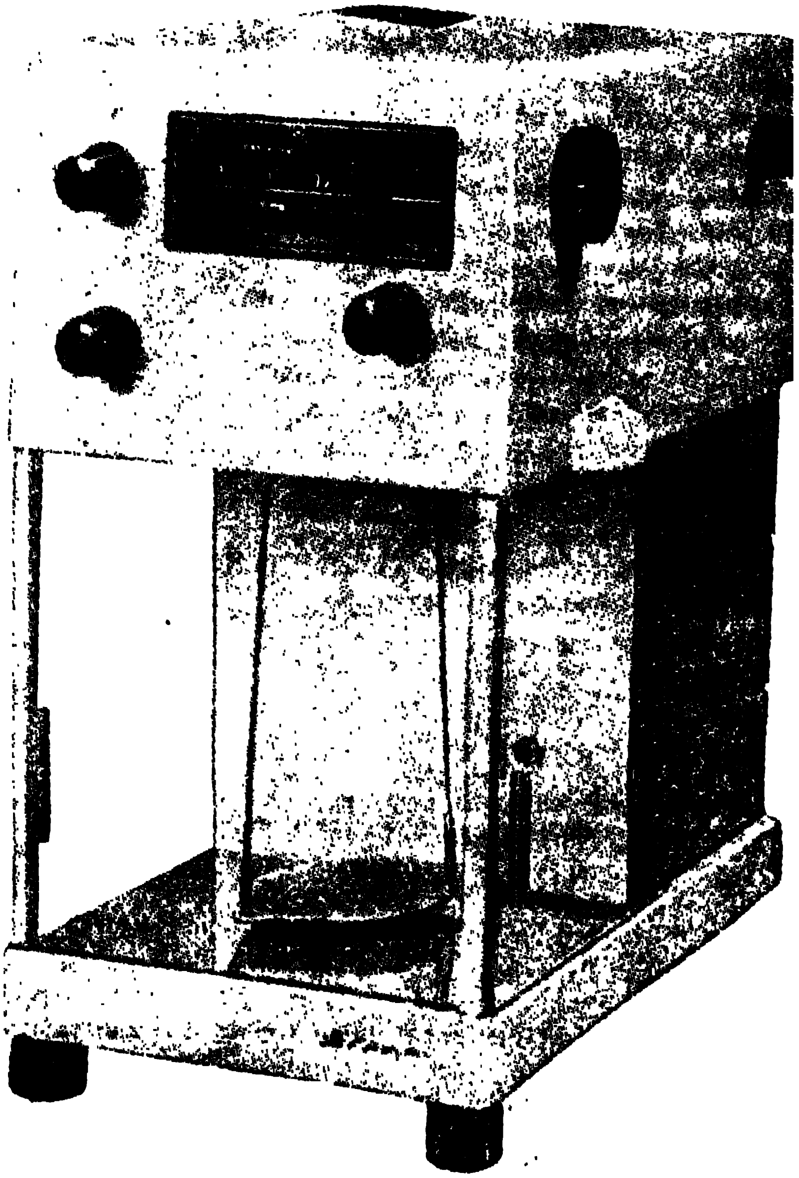

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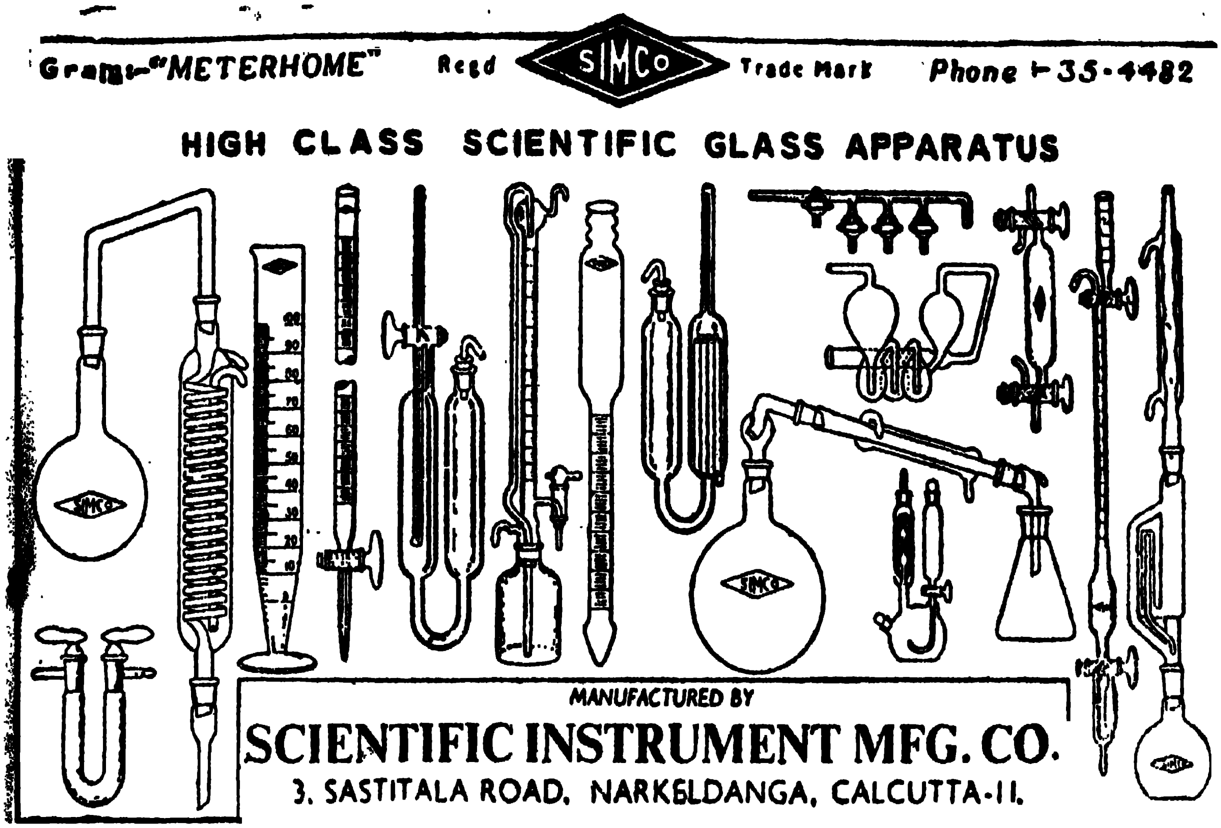
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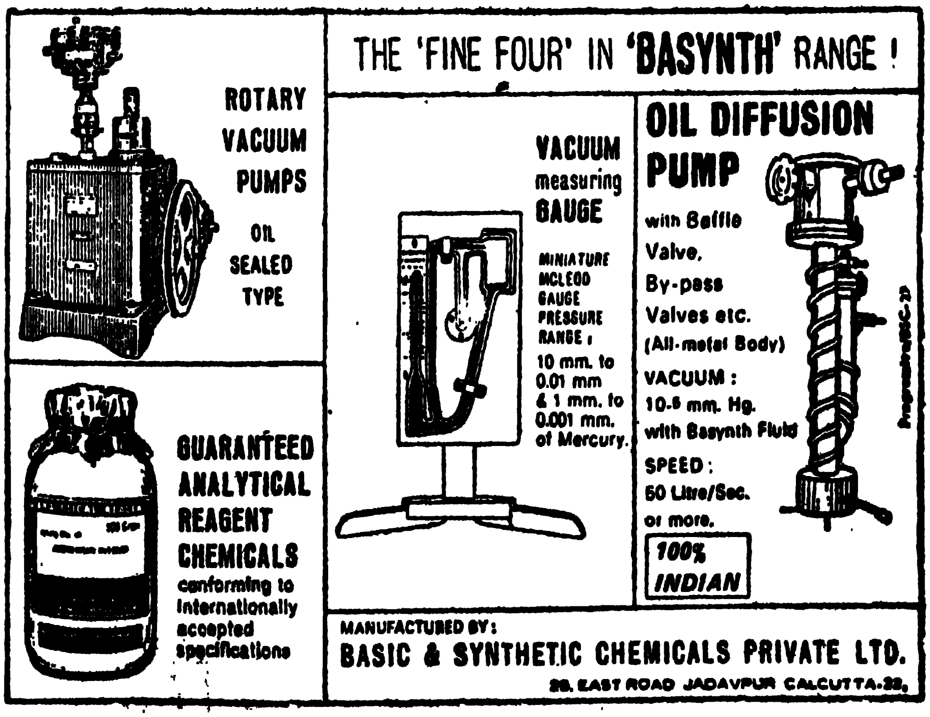
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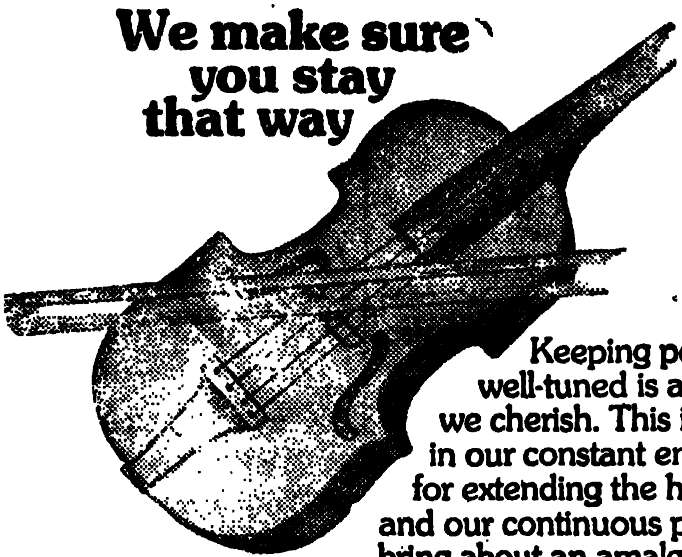

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SCIENCE & CULTURE

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POVERTY AMELIORATION PROGRAMMES

IN India 3.5 per cent gross aggregate growth and 1 per cent per capita growth has been unable to improve the economic condition of the bottom segments of society and thus it has failed to involve the poorest of poor people in the growth process. Hence the Central Government has introduced some special programmes for poverty alleviation. The largest of these programmes is Integrated Rural Development Programme (IRDP). Other programmes include special employment programmes aimed at providing supplemental wage employment opportunities such as National Rural Employment Programme (NREP) and special area development programmes. These new programmes are in addition to Minimum Needs Programme (MNP) introduced earlier for providing some key social consumption inputs for improving the quality of life of the rural poor. The largest of these schemes is IRDP ; here the idea is to select 600 families from each administrative block every year who are below the poverty line, select viable economic activities in each region and involve the family with the economic activity. Necessary capital equipment is provided by the Government as subsidy, the bank is offering capital loan as monetary input and the family is supplying the necessary labour. It is like a triparty alliance to lift the poorest of the poor families from object poverty. It is expected that in the Sixth Five Year Plan about 15 million families will be covered. From this joint venture whatever is produced milk, poultry, pigs, cart wheels toys—if sold in the market, will raise their incomes and push them above poverty line. This programme is extensively implemented, but it passing through teething troubles which according to Planning Commission may not continue long. Based on this idea the commission is proposing much higher investment during the Seventh Plan on these programmes.

The problem is not so simple and easy. Lot of details are required for planning, implementation monitoring and concurrent evaluation and expost evaluation of these programmes at various levels viz. village, block, district, State and the Centre. It appears that the present system of data collection, compilation processing, maintenance and analysis is greatly biassed towards the needs of centralised planning and has not yet been fully geared to what may be conceived as another very important newly emerging area viz. decentralised planning starting at the grass root level. Thus the picture of the effective implementation of these schemes as offered by the Central Government is blurred. Mahatma Gandhi stressed on decentralised planning taking village as Unit in his ideas on economic reconstruction of India in the thirties of this century. The Janata Government at the Centre also mentioned this in their plan document. But never they were seriously tested. Amount and type of data required to be collected and processed at each level and their method of collection on the one hand and the nature and mode of operation on the other hand are expected to be significantly different for a highly decentralised planning process as compared to a centralised one.

We feel that not only for the success of these schemes, these programmes should be saved from exploitation by the middlemen on the one hand and from the mass percolation of the bureaucracy on the other, but also changes should occur in the strategy for the implementation of IRDP and other allied schemes during the Seventh Five Year Plan. Unless this is done, the results from the operation of these schemes will be only marginal. □

P. K. Bose

SEMICONDUCTING MATERIALS FOR ELECTRONIC DEVICES

PAWAN SIKKA*

Research on the electronic states, vibrations and structural changes of the Amorphous Semi-conductors help us understand these glass like materials, which show promise in switching and amplification, as memories and for silverless photography. The field of amorphous semi-conductors is potentially very large because of the wide range of phenomena and materials it en-compasses.

THE field of materials science is continually expanding; a very important first step in any application of this discipline is the preparation and characterization of materials. Of all the solids that have been put to technical use, the class called semiconductors is one of the most interesting. The advances in semiconductor theory and technology since world war II have provided a stimulus to physicists, chemists and metallurgists in almost all fields of solid state research. In addition, new electronic devices made from semi-conductors have formed the basis of new industry and changed the nature of electronic engineering. The technology as well as associated theory of semiconductors advanced at a very much accelerated pace as soon as single crystal semiconductors with controlable properties became available.

Semi-conducting Materials

A semi-conducting material, is one, as the name suggests, having a conductivity lying between Conductor and Insulator. Semiconductors have an electronic band structure such that one band of allowed states virtually completely occupied by electrons (the valance band) is separated by a forbidden energy gap from the next band of allowed states, which is virtually devoid of electrons (the conduction band). Current flow in semiconductors is due to both motion of electrons in the conduction band and the effective motion of vacancies or holes in the valance band. In many situations, electrons in the conduction band and holes in the valance band can be regarded as free particles, provided that an 'effective' mass is used to include the effect of periodic forces of the host atoms in the crystal. Most conduction band electrons have energies close to that of the conduction band edge, whereas most holes have energies close to that of the valance band edge.

Semiconductors can be divided into direct and indirect band gap types, depending on the form of relationship between the energy of electrons in the conduction band and their crystal momentum.

Specialised impurities known as dopants, when introduced into semiconductors, can control the relative concentration of electrons in the conduction band and holes in the valance band. Pure Germanium is a poor conductor but by the addition of a small amount of impurity, its resistivity can be reduced and the material can be made fit for transistors. Carriers in these bands can flow by drift and diffusion when the appropriate parturbations are present.

---

*Dept. of Science & Technology, Govt. of India, New Delhi-110 016.

Elemental semiconductors: The most important material used in semi-conductor device is Silicon. Single crystal silicon, either pulled by Crozharlaki method or produced by float zone technique have found large application. Semi-conductor industries may use silicon at various stage of processing. Polycrystalline silicon may be used as the starting material and the industry can do all the processing starting from this material. Alternatively, some industries may use only diffused wafers/chips as the starting materials.

Compound semiconductors: Gallium arsenide and Gallium phosphide are semiconductors next only in importance to Silicon and Germanium. Light-emitting diodes (LED), semiconducting lasers, microwave diodes (Impatt gun and LSA), field effect transistors and Schottky barrier diodes are some of the devices based on Gallium arsenide, while Gallium phosphide is used only in LED's. The display area is 'however' a fast changing one and liquid crystals pose a challenge to them. In the semiconductor display area, the consensus seems to be that for numeric and alphanumeric applications. Gallium arsenide/phosphide (which is primarily based on Gallium arsenide wafers as the starting materials) is the best choice while for low current and multi-coloured, green or red, indicator lamp applications, Gallium phosphide may be the right choice.

In recent years, semiconducting tellurides have gained prominance for their applications in thermoelectric generators, lasers, infra-red detectors etc. A few members of this family form glasses on controlled cooling. Along with their semiconducting properties, chalcogneide glasses have tremendous scope of various uses i.e. infra-red optics, image storage devices, Lithography, optical memories etc. Ferroelectric transformation in Ge Te has given a new direction to develop photo-ferro-electric semiconductors,

Amorphous semiconductors: Although the field application of amorphous semiconductors has rapidly grown in recent years, the scientific understanding of these materials is still far behind as compared to crystalline semiconductors. Xerography, solar cells and switching and memory devices are some of their recent applications. The photographic applications have several points that favour these materials against the silver based materials. This alternative to the present photographic materials may become vitally important, if the shortage of silver forseen by exports develops. It may be expected that the challenge of the amorphous solid state in general, and the glassy solid state in particular, will be increasingly taken up as its application possibilities become more widely recognised.

Semi-conducting properties have been noticed in certain liquids and organic compounds, and many of the properties of partially ionized gases as well as liquid electrolytic solutions are similar to those of solid crystalline semiconductors.

Metallic Glasses

Metallic glasses constitute a new species of metallic materials and have attracted considerably attention in the scientific and technological world over the last decade. These materials may be described as glassy or amorphous or noncrystalline from the point of view of their atomic arrangements, but are actually quite different in their properties from the traditional oxide glasses and are known for their transparency and brittleness. The inter atomic band in metallic glasses is essentially metallic in character, as revealed in their reasonable highly electrical and thermal conductivity as well as ductability and malleability. All the same metallic glasses often display attractive combination of physical, chemical and mechanical properties which set them apart from their better known polycrystalline counterparts and also promise many a new technological application for them in coming years.

The characterisation of metallic glasses has been taken up in a big way in recent years in many parts of the globe, but progress has necessarily been slow because of the large number, wide ranges, as well as complexity in composition and special methods of production of these new materials. Standardization of production techniques, coordination between laboratories and intensive studies of selected binary metallic glasses, can, however, be safely expected to register significant advances in our understanding of the varied electronic and atomic structures of the metallic glasses before the end of this century. The importance of the formation of metallic glasses can be judged from the fact that a Silver Germanium glass has been made by Indian and Soviet Cosmonauts, on 8 April 1984, in Souej 7 in zero gravity environment in order to obtain its unique structure for new applications.

Position in India

Development of new materials has been integral part of industrial expansion in economically developed countries. Such inventions, in some cases, apart from improving the efficiency of production and quality of products have also revolutionised the nature of certain industries. The Science & Technology of materials have attained such a degree of sophistication that it is now possible to tailor-make materials of desired properties in order to satisfy specific needs of industry and society.

It has been found that certain raw materials of which India has the largest deposits in the world are exported only to be imported back to the country as the finished product at a high cost to satisfy the needs of certain industry. There is, therefore, such room for materials development within the country for its immediate needs.

It is significant that in many of the modern areas of materials development, certain National Laboratories have considerable expertise and developed such materials. The fact should be exploited in determining the policy of materials development, because such activities have the potentialities of opening up new areas of industrial growth. Most programmes geared towards developing indigenous technology will invariably culminate in the growth of new industries for manufacturing special materials and will create more job opportunities in return. Also such development will not result in saving a good amount of foreign exchange but will also earn it by way of exporting certain indigenous product such as mica products etc. ☐

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III. TRAFFIC AND TRANSPORTATION

TRANSPORTATION IN METROPOLITAN CALCUTTA

(Key-note Address)

S. K. ROY

C. M. D. A.

Calcutta

I must admit in the beginning that it would be beyond me to try to write any prescription for transportation in Calcutta beyond 2000 AD. I would rather try to bring out the key issues and provide necessary background to set the stage for discussion.

The structure of metropolitan Calcutta has been largely guided by the transport network. The river Hooghly acted as a major transport corridor in early years and guided the linear growth of his metropolis. The railway alignments in north-south direction parallel to the river strengthened this linear structure. The river, however, has not been properly utilized for intra-urban transportation in this metropolis. It has been used for some ferry services, but its full potential is yet to be explored. Railways do play even now a very important role in the metropolitan transport scene. In Calcutta Metropolitan Area (CMA) 12 railway alignments with 280 km of network and 85 stations provide long distance passenger service, suburban passenger services and goods movement facility. In 1978-79 suburban railway system handled a total volume of 17.18 lakh passengers per day. In 1974-75 the goods traffic handled by the railways was about 8.8 million tonnes.

During the last four decades, however, automobile has become the dominant mode of transport. The CMA is connected to its hinterland by four National Highways and seven major state and district roads. The regional road network is supported by a number of metropolitan highways and arterial roads. Despite the rising cost of fuel automobile registration has steadily increased reaching a figure of 1.5 lakhs in 1980. Road network handled about 77.41 lakh transit passenger trips per day in 1978-79. Road transport handled about 11 million tonnes of goods in 1974-75. Rapid growth of automobile transport has brought with it a number of problems. The most commonly realised problem is the traffic congestion. The CMA has only 6.4% of its total land devoted to roads. As a result acute congestion has become a chronic problem in the city. There is acute shortage of parking facilities and the roads are often used for parking. This reduces the capacity of the roads and the mobility is affected. The footpaths are encroached upon by various other non-transportation activities and as a result pedestrians are forced on to the carriageway. This increases pedestrian hazard and reduces the capacity of the carriageway. The roads are to carry both fast and slow moving vehicles. Management and enforcement of traffic operation and control are rather weak and user discipline is almost totally lacking. The transit facilities are far too inadequate compared to the demand. This creates long headways, long waiting at transit stops and crowding in the vehicles. Transit travel speed is low because of traffic congestion and travel schedules are uncertain. The terminal facilities are inadequate resulting in uncomfortable and unsafe loading and unloading, difficulty in transfer, and delay in operation. The route structure is inefficient and intermodal coordination is poor. All these result in high cost of operation which in turn limits the supply of facilities and, therefore, the gap between the supply and demand is daily increasing. The situation in goods transport is also very depressing. The movement of trucks, their loading and unloading, servicing, repairing and fueling have adverse effects on the quality of urban life. At the same time the city cannot live without the trucks. In absence of planned facilities, the central area is being indiscriminately used for such purposes. This has complicated the traffic problem and the efficiency of the central area is gradually decreasing. The growth of automobile travel has also resulted in increased accidents and environmental pollution. The noise level has increased much above the desirable limit. The emission of carbon monoxide is creating health hazard and there is steady encroachment into open spaces to make room for increased need for transportation.

If this be the picture of Calcutta 1984, what would happen to it beyond 2000 AD ? If past trends are continued unckecked, the prospects of meeting the future transport needs appear to be rather depressing. Possibilities, however, do exist for bringing significant improvement to the situation if an overall view of the total transportation system for the CMA is taken, and the transport development actions are coordinated to provide an integrated transport system for the CMA in which all the different forms and modes of transport could be fully utilized in a manner that they become complementary without being competitive to each other,—thus resulting in a balanced total transport system for movement of people and goods. This requires that total transport plan should be formulated within the overall development policy framework. Transport demand in future should depend on the pattern of future growth and modal choice. Broad guidlines in this regard indicate that,

(a) There would be dispersal of metropolitan activity from its presently congested core to the outer areas.

(b) In the hinterland and in the State, other urban centres, small and medium towns, would be developed to reduce the acute primacy of the CMA.

(c) Electric traction would be preferred and encouraged for reducing oil demands in transport and for reducing environmental pollution.

(d) Railways will continue to remain as the most effective mode of transport for high capacity corridors.

Considering the development structure in the light of the above guidlines, transport demand in future may be estimated. It is assessed that by 2001 AD suburban railway passenger may be 32 lakhs per day and railway goods traffic may rise to 7.7 million tonnes per year. Transit passengers by all other modes would become 149 lakhs. Automobile registration in CMA is expected to reach 3 lakhs and goods traffic by road may rise to 19.6 million tonnes.

For meeting the future challenge transport development should be organised in two main directions :

(a) Increasing the supply of facilities through implementation of new projects/schemes.

(b) Increasing the efficiency of the existing system through traffic operation improvement measures, increasing the productivity in the public transport and through various other measures of improving the efficiency of the system including introduction of restraint measures where necessary.

The first step in developing an integrated transport system is to formulate a plan and programme. For lack of time I cannot go into the details of the planning process and the plan components. But let me highlight briefly the key issues that deserve special attention :

(*i*) *Relating transport system to Metropolitan Structure* :

The future transport system should be related to the urban form and land use with a view to reducing transport demand. Dispersal of central area activities should be given due weightage. The objective should be to distribute services and facilities, achieve closeness of jobs and residances, reduce pressure on the congested core and contain chaotic sprawl.

(*ii*) *Integration of Transport Network* :

In Calcutta the total transportation is a complex phenomenon with multiple modes, slow and fast, providing goods and passenger movement. The performance of the total system is controlled by the efficiency of all the subsystems, the individual modes. This requires that the metropolitan transport should be developed as an integrated total system. The integration of the network of the railways, roads and waterways is the essential first step to achieve a total integrated system. This has been sadly lacking in the past. Efforts should be made to achieve desired coordination and integration of the different modes and forms in a balanced manner.

(*iii*) *Central Area Circulation :*

The transport system in the central area is under serious strain and the quality of travel has gone down to a very low level. This has seriously affected the efficiency of the central area. The need and importance of an efficient central area in metropolitan life can hardly be over emphasised. It provides specialised urban services and functions including (a) acting as centre for metropolitan business, commerce and trading activity, (b) providing facilities for acting as economic nerve centre for the region, (c) for functioning as the administrative headquarter, (d) acting as a major transport node for regional, national and international passenger and goods movement, (e) for acting as the Head Quarter for higher education, health, art, culture and recreation as well as other social and political activities. In the central area of Calcutta there is high level of congestion at the ground and streets are packed with people but paradoxially the level of nd utilization is extremely poor and the floor area ratio is low though the land value is sky high. Analysis of current situation in the central area indicate that opportunity still exists to significantly change the trend of events and the efficiency of the central area can be increased to a considerable extent. The transport in central area should receive special attention in the years to come. The elements that need special consideration include :

(a) Parking policy.
(b) Rationalisation of central area land use.
(c) Restraint on truck operation.
(d) Restraint on automobile traffic in selected areas.
(e) Introduction of better traffic control, operation, management and enforcement measures.

(*iv*) *Truck Terminal-cum-Wholesale Trading Centres* :

To relieve the congestion in the central area, wholesale trading activities and the functions of transport operators should be shifted to the periphery of the metro core. To achieve this, truck terminal-cum-wholesale trading centres should be established at appropriate locations. These terminals should be integrated with major railway goods terminals and be served by the railway alignments. This should receive adequate attention in the future years.

(*v*) *Ferry Services* :

Water transport has tremendous potential for Calcutta. The Hooghly may provide efficient ferry services along and across the river which will bring substantial relief to the land transport in this metropolis. The scope for utilising the canal system for some inland transport services should also be explored. Water transport offers a major area of future hope.

(vi) *Integrated Transit Structure* :

The various modes of mass transit services should be fully coordinated and integrated in future. Integration and coordination should be attempted in respect of (a) route structure, (b) terminals and modal transfer arrangement, (c) operation and scheduling, (d) fare structures and (e) management.

The areas that receive special attention should include :

(a) The Metro Railway and its integration with the surface transit ;

(b) Ferry transit and its integration with other modes ;

(c) The Circular Railway and its integration with the Metro Railway and the surface transit ;

(d) Conversion of some railway goods yards to passenger terminals, reorganisation of existing railway terminals and expansion of the railway network.

We have seen in the recent past efforts to apply the so-called comprehensive planning technique developed in the western countries particularly in the United States during late 1950's and early 1960's. Attempts are made to undertake very expensive and time consuming planning studies to develop mathematical models for projecting future travel demands. A Master Plan is then drawn up with all sorts of facilities to meet the future demand. Since long term projection for basic travel motivating factors like land use, employment, etc. is very fluid in our situation, such efforts of transportation planning really become crystal ball gazing and then recommending a sophisticated utopia of mobility. Planning of this kind is of little help to our situation. The main purpose of transportation planning should be to guide effectively the investments to be made in the transport sector so as to maximise the total system benefit. To do this, transport planning must recognise the current and future realities in formulating the alternative future scenarios and analyse the policy issues, examine the impacts and implications, evaluate the alternatives and then prepare investment plan for action programme. Continuing monitoring, updating and adjustment should follow. Such a planning process may not promise perfection but surely shall promote progress. And that is what we need most. ☐

URBAN TRANSPORTATION

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Before the Second World War, Calcutta was a great metropolis. Unfortunately, within about 36 years after independence Calcutta has become a necropolis, a city of the dead and dying, fast putrefying, forsaken. The implied though unsavoury, truth behind this comment is that the "genius of our native-born leaders" has turned Calcutta, the "magnificent city of parks, gardens and splendid buildings of the twenties" into what it is today. It is true that Calcutta's problems are mainly a legacy of history. But one thing that seems clear is that our ethos stand in the way of our urban development. Since independence, Calcutta has become the happy hunting ground of profiteers whom do not care for its well-being. People seem to have become inured to squalor. Nobody asks why Calcutta should perpetually fail to provide better standards of civic services and amenities.

The talent, expertise and professionalism in various spheres which make and sustain the quality of life in a city are becoming increasingly rare in Calcutta. The city was once famous for attracting and nurturing the best from all over the country ; no longer so. Intellectual and professional excellence, catholic tastes and sensitivity of mind flourish when the physical quality of life index (POLI) attains a certain level. POLI is a widely accepted scientific measure of the effectiveness of social services and also includes such components as life expectancy, literacy, infant mortality, etc. POLI is very low in Calcutta and has always been so in the past. How is it then that, despite this, Calcutta was a centre of excellence ? It was largely because the urban middle class provided encouragement, patronage and inspiration, aided by munificence of the upper-middle and rich sections. The economic decline of these classes, abetted by a fast declining POLI and relatively abject growth of other areas—all taking place most significantly in the 50s and 60s after independence—have led to the present decline. Transportation is the most important component of POLI of any urban complex. A city depends for its growth and development on its urban transportation facilities and its competence to render better standards of civic services. Unfortunately, the transportation system in Calcutta presents a sordid spectacle of neglect and absence of proper management.

Basic Inputs for Calcutta's Transport Planning

Some of the major problems of transport system of Calcutta are widely known. The road space is one of the smallest per square kilometre of urban area in the world, the quality and maintenance of roads are bad ; the traffic jams are caused by the linear development of the city and the movement of traffic during rush hours twards or away from the Central Business District, the presence of two major traffic bottlenecks around the two railway stations, the high proportion of slow moving traffic, lack of adequate number of buses, all these have been discussed many times over the past three decades. It is also true that over the last two or three years some serious attempts have been made to speed up the work on the underground railways to remove peddlers from areas of traffic congestion and to construct flyovers in busy areas. Such measures would have their effect on the life of the city in the years to come. I would like to point out in this connection that whatever the traffic policy and planning has been adopted for improvement of the transportation system in the city, it appears that the inputs in planning have not considered the link between the transport system on the one hand and the social life in the city other. Transport is an important differentiator in the social life of the city. In fact, the transportation system in a city is a measure of social services catering to the needs of the city users.

One important, distinguishing feature of city life in Calcutta is that the affluent segment of the society prefer to live not far from the city centre, whereas the trend in the developed countries is for the poorer section to live in the heart of the city while the affluent section enjoy the luxury of space and green in the suburbs and countryside. Had the suburban transport system been more regular and less crowded, those living in Chittaranjan Avenue and Chitpur might have opted for places like Madhyamgram or Barasat or even Basirhat.

Another important feature of the city life is that it is stratified by the mode of transport used, which again is correlated with income, education, status and so on. A majority of the city population undertake journeys to their destinations in the city mostly on foot—which explains largely the pedestrian overflows into the roads in many areas. Buses, trams and mini-buses and occassionally rickshaws particularly during rainy days, are the main modes of transport for the city's poorer and middle class. The strong emotional feeling of both affection and hatred—towards such vehicles on the part of a large section of the population which accumulates over time through many crowded journeys, often finds violent expression. The upper middle class and the rich own their independent means of transport, which sets them apart from the rest of the population in Calcutta both spatially and socially.

The other factor is that Calcutta is better linked by road and rail than any other city or urban area in the eastern region. In the years of drought, flood, or other natural disaster, people come from rural Bengal, Bihar, U. P. and Orissa to Calcutta for shelter and sustenance. Many of the refugees from East Pakistan came to the Sealdah Station first and then they were dispersed to the countryside or other towns. Had the other urban centres been better connected by road and rail with their rural hinterland, the flow of migrants to Calcutta might not have been as excessive as it have been over the decades of forties and fifties. Certainly transport is not the only factor influencing the direction of migration of outsiders to the Calcutta urban area, but the presence of economic opportunities and better civil administration are even more important factors. Nevertheless, the uneven development of transport system in the Eastern region has provided the thrust for migration of rural people to the metropolitan area of this city.

The issues related to transportation cannot therefore be judged in isolation of their social context. I would therefore urge that those shaping the transport policy including the transportation planners should have a clear idea of the kind of settlement pattern, urban rural and centre-periphery relationship and have in mind whom the transport policy is going to serve. Transportation planning is not merely a matter of measuring traffic flows and perfecting technical designs ; it is essentially about people whose life, livelihood, social behaviour and attitude would be greatly influenced by such planning.

While reverting to the technical aspects of transportation planning it is necessary to have energy efficiency as a dominating input in the selection of suitable transport system. Since the last world war, there have been remarkable developments in the hardware and software of transportation science to meet the ever increasing challenges and demands of services, growing complexities of the system and the requirements of economic viability. Energy efficiency in transportation has always been an integral part of analyses and studies carried out with a view to increase the efficiency and viability of transportation systems. Oil crisis of the recent past has caused revolutionary changes in the systems and thinking in urban transportation. In India, we are spending about 45% of our annual foreign exchange earnings for importing crude oil. Thus the situation in our country is very acute. Since transportation accounts for a very considerable proportion of the energy consumption, energy efficiency in transportation is of vital importance to us and we need to ensure that we utilise this scarce resource more effectively. The report of the Inland Water Transport Committee (1970), Government of India, agrees with Bhagwati Committee's findings and gives the comparative costs and efficiencies for different modes of transport (Table 1).

Significantly this study indicates that the road transport is more energy expensive than rail transport which in its turn is more energy expensive than water transport. Before comparing the energy efficiencies of various transportation systems, all the comparative systems should first be brought to their individual optimum levels of efficiency. Ideally, the design of the engine, the road and the modes of traffic flow and control should be oriented towards fuel efficiency. Design of fuel efficient cars has also received much attention the world over. For instance, the following potential savings in fuel consumptions are considered realistically accessible :

(i)	Three axle vehicles	10%
(ii)	Enforcement of speed limits	8%
(iii)	Better driving practice	10%
(iv)	Abolition of octorois and check posts	15-17%
(v)	Better vehicle maintenance	4-5%

TABLE 1

Mode of Transport	Cost in Rs. per kilometer		Load per Horse power (Kg.)
	Construction (Rs. lakhs)	Maintenance (Rs. per year)	
Waterways	1.25 to 2.00	1,000	4,000
Railways (B.G.)	8.00 to 10.00	9,000	500
National Highways	1.50	4,500	250

No efforts seem to be evident in achieving any of these in the transportation planning for Calcutta. With the syndromes of a catastrophe visible all around, the consideration of energy efficiency of transportation systems can hardly be postponed too long.

A "journey time" study of vehicular traffic in the core area of Calcutta Metropolitan District has shown that during the past 12 years, the travel speed on important stretches of major roads has gone down by 3% a year.

The speed has dropped on 38 major roads. It has fallen by 50% on parts of Old Court House Street, Bidhan Sarani and R. G. Kar Road. On 13 other roads it has dropped by over 30% compared to the 1965-66 level.

The speed has improved on 11 major roads with a maximum rise of 62% on a section of Raja Dinendra Street. Similar acceleration has been noticed on stretches of Brabourne Road and Sarat Bose Road. Construction of the fly-over on Brabourne Road and widening of the other two roads are said to have brought about this improvement. But there is hardly any scope for widening the carriage-way of some of the arterial roads like Rabindra Sarani and Bidhan Sarani. There are 41 north-south "corridors" and 53 east-west "corridors" in the core area of the city.

About 6.3 million people move about in Calcutta every day in trams, buses and minibuses. About 10% more travel by private car.

Yet another cause of the declining travel speed is the presence of slow-moving vehicles like rickshaws, hand-carts and bicycles on major roads.

A survey in the Burrabazar area showed that 8,163 slow-moving and 7,875 fast-moving vehicles crossed a particular point on Mahatma Gandhi Road in 12 hours. This explains why the peak hour journey speed on the road west of Rabindra Sarani has dropped by 24% over the past 12 years. Much of the congestion on the Howrah Bridge, which carries the largest volume of traffic in the core area, may be eased by banning the entry of slow-moving vehicles. About 28% of the 38,700 vehicles that crossed the bridge during a given 12-hour period were slow moving.

But even if there were no slow moving vehicles, narrow carriage way and traffic overload can create bottleneck on busy roads. On Old Court House Street, where such vehicles are not permitted, the peak hour speed has dropped by 60%.

The Government has not yet taken any decision on the proposal to withdraw tram services from Rabindra Sarani and Arabinda Sarani (Grey Street) and remove the reserved tram tracks from Acharya Prafulla Chandra Road. Some may observe these steps to cause hardships to commuters, but as stated elsewhere, these measures can be taken in stages where in each stage there shall be substitution by fast moving vehicles.

Perspective planning for transportation for Calcutta Metropolitan Area

One way of shirking the labours of urban renewal is to plead that Calcutta being an unplanned city, and its problem having piled up into a tower of distress, nothing can be done to make life here pleasanter. The period between 1870 and 1914 was one of maximum prosperity in Calcutta. Very little of it was reflected in city improvement. But cities need large scale alternations from time to time. Rome had its first plan of urban re-shaping as early as 1590, and London in 1680 and again 1811. Paris had several replannings till 1853. There has been nothing like that in Calcutta so far, until a few years back the C.M.D.A. was set up to look after all aspects of urban renewal. Before working out a perspective plan for the transport system in Calcutta beyond 2000 A.D. it is necessary to examine the present situation of transportation and its infrastructure which are intended to serve as a base line for perfecting future transport planning. The city which can accommodate about nine hundred thousand people is now providing shelter to about ten million. Road space available for movement of traffic is only 6% against 10.6% in Bombay, and 18.6% in Delhi. The meagre space is being used by at least 1,50,000 vehicles, 30,000 of them being goods carriers, 50,000 to 60,000 private cars, 4,000 private buses, 700 state buses, 300 trams and thousands of taxies along with mini-buses. Hundreds of slow moving vehicles like rickshaws and hand carts are also moving along the existing roadways and are free to hinder traffic flow. Hawkers, under patronage from some powerful corners, have encroached on pavements and roads and their number continues to swell. About 1.3 M. daily passengers from the suburbs use the existing transport and other civil services every day. Though the fare structure had been revised several times during the past few years and despite huge subsidies from the State Government, both the C.S.T.C. and the C.T.C. continue to incur a huge loss. Even the World Bank-aided Calcutta Urban Transport Project (CUTP-1) of Rs. 102 crores has failed to give a fresh lease of life to either of these agencies. There is an evident lack of direction at the managerial levels, especially at the C.S.T.C. and C.T.C. Surprisingly, while the public transport organisations are languishing, the newly introduced ferry services have started to prosper. They carry about 70,000 people each day. This effortless success has surprised even the Transport Department. In recent years, the right of way of vehicles on roadways is being increasingly taken away by pedestrians who find the footpath blocked by hawkers, dumped goods of transport operators, shops and garage owners and wheelbarrows of the corporation. The city traffic police authority shudder at the thought of closure of Chittaranjan Avenue for the construction of the underground railway. The fear is that even after widening of the other north-south corridors, they will not be able to cope with the volume of diverted traffic. Had the construction of the Eastern Metropolitan Bypass been completed by now, much of the north-south traffic could have been diverted by this road.

The present chaos in the transportation situation in this city is mostly due to disjointed thinking and lack of will and efforts to enforce transportation policies and plans. The following situations are examples of such distortions in strategy regarding step by step measures for curing the ills of transportation.

(1) For over three years now, the Canal East and West roads, widened and strengthened at considerable cost by the C.M.D.A., have been lying unused. These two roads could have been used by trucks, bypassing already over saturated north-south corridors between Sealdah and Shyambazar. Because of their non-use and poor lighting, the two roads have been encroached by timber godowns and anti-socials are active at night.

(2) Calcutta Port Trust's Strand Bank Road can be developed for taking the goods truck traffic. The 55 ft. wide road, now being used as a dumping ground by the local godown owners, originates at No. 9 Calcutta

Jetty and ends at Baghbazar. This road can be made fit for use by trucks leaving Calcutta from Posta, Port and elsewhere in south Calcutta or entering these areas, without congesting Howrah Bridge and the Central Business District.

(3) Construction of a truck terminal by the side of the Eastern Metropolitan Bypass near Park Circus had been suggested long ago by C.M.P.O. as a measure to keep the large number of trucks outside the municipal area of the city. In 1974, many of the transport operators had shown interest to shift their godowns and terminuses from the congested areas of the city to the above suggested site considering that this would bring down their recurring costs and ensure quick turnround of vehicles. Since then, the scheme has not been implemented and the problem continues to aggravate with passage of time.

(4) Absence of a proper land use policy and long term perspective planning have also contributed to the traffic bottlenecks. High rise appartment and markets have been allowed to be built in areas without sufficient roads space and without provision for adequate car parking space. Even the Government projects like the multi-storied commercial complex at Sealdah and the one-lakh capacity stadium at Salt Lake have no proper provision of parking space for vehicles.

(5) It appears that there is absence of serious thought for proper dispersal of 1.5 million commuters who will use the underground rail at the end of the decade. The proposed over-ground provisions for passenger dispersal at various M.T.P. stations are too inadequate and are surely going to create serious bottlenecks in traffic movement. The Metro Railway would not be able to cope with the traffic explosion in the city by the time it starts functioning in 1986 because the number of daily commuters would be more than 8 million whereas the Metro would carry commuters between 1.1 to 1.5 millions. The figure of daily commuters will go up to 9.7 millions at the beginning of 2000 A.D.

(6) Today Howrah and Sealdah terminuses are being used by about 1.7 million commuters, on an average, every week day and the figure is expected to rise to 3.2 million by 2000 A.D. The proposed circular railway would help and ferry services should be improved, which would reduce some of the pressure on the Howrah and Sealdah terminals. Nevertheless, such nearly 100% increase in the number of commuters should be considered an important input for transportation planning for this city beyond 2000 A.D.

Even after the Metro Railway, the Second Hooghly Bridge and the Circular Railway become a reality, the traffic and transport problems are not likely to be eased, given the pressure of population. More growth centres need to be built to take the pressure off Calcutta and the goods carriers must not be allowed to enter the city. It is urgently necessary to set up the truck terminals at Kona as well as at Dakshineswar. Besides above, the Central Business District should be made free of tramway services, preferably in stages, an outline of which is being discussed in the following paragraphs. All forms of slow moving traffic should also be prohibited to run in this area. There may be criticism against these measures from some sections of the population in Calcutta, but it may be asserted that these criticisms emanate from short-sightedness and should not be allowed to deter implementation of the above policy.

Strategic Planning for Transportation Beyond 2000 A.D.

After discussing the basic aspects and causes of the critical stage of transportation in the city at present, it is necessary to project the requirements of commuters beyond 2000 A.D. and to formulate the planning strategy for these aspects. Accordingly, the following suggestions are presented for serious study and consideration of policy making authorities and implementing agencies for urban transportation projects in Calcutta.

(1) Efforts should be made for immediate use of Canal East and West road by trucks by providing better street lighting arrangements. Statutory enforcement for use of these roads by trucks for movement between Sealdah and Shyambazar should also be made simultaneously.

(2) Strand Bank Road should be developed for use of trucks entering and leaving Posta and other destinations in North Calcutta. Until the Second Bridge is commissioned to traffic, the above road should also be used by trucks entering and leaving the Port and other destinations in South Calcutta as an interim measure and this traffic shall finally be diverted over the Second Howrah Bridge after it is commissioned. This scheme shall serve dual purposes, namely, diversion of trucks from the busiest central business and commercial areas and de congestion of Howrah Bridge.

(3) Proposal for the construction of a truck terminal at the Eastern Fringe of Calcutta by the side of Eastern Metropolitan Bypass should be given serious thought for immediate implementation. However, if C.M D.A. proposes to have more extensive plan in this area there should not be any difficulty in incorporating this scheme as a first phase integrated into the overall extensive scheme. This is necessary to relieve the congested areas lying within the Central Business District at present occupied by transport operators.

(4) A proper land use policy and modifications to municipal regulations should be taken in hand immediately taking into account of the projected future growth of traffic and population in the metropolitan area. Plans for high rise building should be sanctioned only if proper car parking space is provided within the premises on surface or underground.

Although, it will be difficult to generalise the land use pattern of towns and cities in India, approximately 8% to 10% is used for industrial and manufacturing activities, 3% to 5% for commercial purposes and 7% to 15% for parks etc. The remaining land is taken up by roads and other utility services. Table 2 will give an idea of existing land use pattern in 4 metropolitan cities in India.

TABLE 2

Cities	Residential Units (Numbers)	Office accommodation (Lakh Sq. m.)
New Delhi	56,622	0.99
Bombay	21,434	1.02
Calcutta	46,363	1.39
Madras	13,885	0.78

A greater number of business houses and industries came up in big cities, without concomitant increase in the number of residential units for the lower middle class and poorer sections of the city population. Thus what followed were an acute shortage of housing for the low income groups, an unending migration from villages to cities and abnormal increase in prices of urban land.

These, in turn, have been contributing to proliferation of slums and squatter settlements. Considering these phenomena, the C.M.D.A., Bombay Metropolitan Regional Development Authority and the Delhi Development Authority have been trying to devolute the mono-centric growth of these cities. However, the implementation of their programmes along these lines have not yet produced the desired results which may take some more time. Consequently, the lower income and middle income groups, which constitute over 3/4ths of the affected masses in urban areas, have yet to derive the benefits of these programmes. The fallacy of providing housing in an over-congested centralized metropolis like Calcutta is borne out by many factors amongst which the increasing cost of rental is primary consideration. On the contrary, the transport bottlenecks in and around the metropolitan area like Calcutta are related to the social aspects of over-crowding in the metropolitan area. The solution to the above problem lies with decentralisation of activities in the satellite townships of Calcutta. In these satellite townships, attention should be given to factors like low infrastructural facilities and the land use pattern which should be based on low-energy transport system wherein the padestrian, cyclist, public transport system and where necessary, the mass transport system should be conceived in an integral manner.

(5) M.T P. authorities shall be urged to provide proper dispersal arrangements for commuters at surface level at each station so that the flow of traffic around the station is not interfered by a sudden influx of pedestrians at a particular locality at any point of time.

(6) Eastern Railway and South Eastern Railway Authorities should be asked to work out a scheme for expansion of their terminals with provision for further future growth of the Howrah and Sealdah Terminuses to cater to the needs of about 4 million commuters which is anticipated to use these terminuses by 2000 A.D.

So far a number of critical areas of the existing chaotic traffic condition in the metropolitan area have been discussed and recommendations for their improvement have been put forward. But the overall solution lies in the adoption of certain radical measures in addition to what has been discussed above.

In the above paragraphs some of the critical location developments have been discussed which shall form part of the integrated strategic planning for the development/improvement of the transportation system in Calcutta Metropolitan Area beyond 2000 A.D.

The proposed radical schemes which are also necessary to be incorporated in the integrated strategic planning are described below :

(a) By 2000 A.D. the Second Hooghly Bridge being in commission shall cater to the needs of traffic entering and leaving most parts of South Calcutta and the Southern Metropolitan Area including the Port. But the infrastructural facilities for northern parts of the city and the Northern Metropolitan Area will not be balanced unless a provision for crossing the Hooghly is made at a convenient location. This location is identified to be across the Hooghly, connecting Gun Foundry Road and Eastern Metropolitan Bypass at Calcutta side and a suitable branch road to be developed from G. T. Road on Howrah side. Pending construction of a suitable bridge at this location, the crossing of traffic for commercial, industrial and public utilities can be maintained by deploying suitable ferry services across the Hooghly. Once this crossing is established the traffic to and from the northern areas of the city and the metropolitan district shall travel to Howrah and beyond over this crossing. Moreover, the traffic to and from the Port area and the southern parts of metropolitan district which are bound for northern parts of Howrah and other northern states should bypass the city roads and the Second Hooghly Bridge and follow the Eastern Metropolitan Bypass, Dum Dum Road and Gun Foundry Road for crossing over by the ferry or the Bridge at a latter stage. It may be noted that this traffic should not interfere with the traffic to and from the Dum Dum Airport and a grade separation at a suitable location should be constructed.

(b) The existing chaos in transportation in the metropolitan area is to a great extent due to improper traffic management and lack of will on the part of the authorities to enforce traffic regulation. In this context, it is suggested that the Central Business District shall be made free from slow moving traffic of all forms. It may be appreciated that due to the lapses in the enforcement of traffic regulations, the growth of unlicensed rickshaw, hand carts and other forms of manually driven vehicles have reached such a proportion that many of the streets in the business are during working hours become virtually choked with these vehicles. This situation should be radically improved.

(c) A rail link from Behala area shall be established and connected to the Budge Budge line, before the circular railway enters the K. P. Dock area. An interchange between the above Budge Budge/Behala line and the circular railway shall also be established at the location as stated above, by introduction of a single through ticket.

The Circular Railway system should be operated in such a manner that a commuter on single ticket can travel to his destination in the city by train and by C. S. T. C. buses. In this connection, it is suggested that a unified transport authority to monitor the suburban railway system and to ensure proper linkage of electric trains with the C.S.T.C. services be set up to enable the commuter to travel on a circular railway cum bus journey.

Ultimate Planning

(i) Re-building and re-development of roads, bridges and other infrastructure for traffic circulation and dispersal as discussed above are no doubt important part of the integrated strategic planning for the improvement and development of transportation system in the Calcutta Metropolitan District but the "total solution" will be in sight, only if the metropolitan activities are moved away from congested places by developing areas on the fringes of the city.

Decentralization should start with developing some areas, near the location where the connector from Park Street meets the Eastern Metropolitan Bypass, as an office and commercial houses at present located in the congested B. B. D. Bag, Esplanade and the central district of the city, shall be encouraged to shift their offices to the above complex. This area may be contiguous to the proposed truck terminal near Park Circus by the side of Eastern Metropolitan Bypass, which will in turn accelerate and assist the growth of commercial and business activities.

(ii) The tramway services to B. B. D. Bag area shall be discontinued by 2000 A. D. As a first stage development, the tram services from South Calcutta and Behala shall be realigned to pass from Dufrin Road to Strand Road and then to Howrah Tram Terminus thereby bypassing the Esplanade and the B. B. D. Bag area. The tram services from Shyambazar should continue along Nirmal Chandra Street and then turn left to Dharamtola Street and finally pass to Acharya Prafulla Chandra Road for returning to Shyambazar. The return journey shall run in the reverse direction. Such a change shall necessitate the construction of a fly-over along the Dharamtola Street and Dr. Sundari Mohan Avenue at their junction with Acharya Prafulla Chandra Road. Simultaneously, the tramway lines from Shyambazar via College Street and Arabinda Sarani to B. B. D. Bag should be suspended. Furthermore, tramway services from Baghbazar via Rabindra Sarani to B. B. D. Bag as well as to Esplanade area shall also be suspended. However, all suspended tramway services should be substituted by fast moving bus services of C. S. T. C. and private operators. Nevertheless, the man power affected by the proposed suspension of routes, would be engaged by the substituted C. S. T. C. services. The rolling stock and the infrastructure shall be diverted to augment the continued route systems.

It is obligatory to construct multi-storied car parking depots at various suitable locations within the Central Business District. The allotment of funds for such construction can be made through contributions from the users, both individual and institutional, as well as from public lending institutions. After construction of the above multi-storied car parking depots, it would be necessary to keep the streets, roads, etc. within the Central Business District including B. B. D. Bag area of Calcutta, free from parking of long duration stationary cars except for cars coming for short duration visits.

(iii) The existing chaotic situation of the surface transport system within the city area particularly with respect to their distribution and destination should be made systematic by resorting to route rationalisation. However, the importance of this work has been duly recognised by the administration of the State transport department and C. M. D. A. as a result of which, this work has been assigned to the London Transport International, a consultancy wing of London Transport Authority. However, in this connection, it may be pointed out that along with route rationalisation it will be necessary to develop new route circulation system within the metropolitan area which should be linked up with a newly developed peripherial circulation system.

The crossing of branch roads with the arterial roads in Calcutta exist at close intervals, sometimes at 100-200 ft. spacing. Vehicles travelling to and from these branch roads very often cause traffic bottlenecks on the arterial roads As such, the intersection of branch roads with arterial roads should also be rationalised and the interval should be increased to 500-600 ft. if possible more, by sealing the intervening crossings.

(iv) Adding to the number of buses would not by itself solve the transport problem, because the traffic capacity of roads in Calcutta have reached the critical value. Moreover, major changes in the road alignment at busy crossings are not possible and traffic overload on existing roads are creating continuous jams. Besides, processions frequently hold up traffic in and around the Central Business District and these factors cannot be alienated from the civic life of Calcutta.

The suggested measures as discussed above, though, will be able to improve transport system to a great extent but it would require to be supplemented with further innovations considering the volume of commuters that it is expected to travel to and from the metropolitan area beyond 2000 A. D. It is suggested that a suitable overhead monorail system should be introduced with two circuits, one each for northern and southern parts of the city respectively having an interchange section between the two. For the southern circuit, I would suggest that the route may start from the junction of Diamond Harbour Road and Nalini Ranjan Avenue run along Diamond Harbour Road, St. George's Road, Strand Road, Auckland Road, Mayo Road, Acharya Jagadish Chandra Bose Road, Circus Avenue to Tiljala Road, Rifle Road and therefrom by the side of the existing railway track shall pass along Prince Anwar Shah Road, Nalini Ranjan Avenue and finally complete the circuit. The the northern circuit, the suggested route shall start from the junction of Kali Krishna Tagore Street and Maharshi Debendra Road and travel by the side of the existing railway track to Gun Foundry Road, Dum Dum Road, pass along the existing railway track crossing over Ultadanga Main Road, Manicktala Main Road, Kankurgachi Road, Beliaghata Main Road to run along Tiljala Road, from where it will pass over to Dr. Sundari Mohan Avenue, Convent Road, Canal West Road, Acharya Prafulla Chandra Road, Vivekananda Road, Kali Krishna Tagore Street and finally complete the circuit. The interchange section between the south and north circuits is proposed to be over Tiljala Road, where acquisition of additional lands may not pose serious problem.

The implementation of the above monorail system should be integrated with the schemes for decongestion of the Central Business District of Calcutta for making it free from congestions due to the operation of trucks and goods transport vehicles together with manually operated hand carts. The above mono-rail circuits, running on electric traction system will not only be fast moving but also will preserve and not deteriorate the environment of the city.

Since one of the immediate solutions for the traffic problem in Calcutta has been identified to be the augmentation of existing fleet of buses and fast moving vehicles and as the fuel crisis poses critical threat to the economy of the country, it is certain that all these vehicles shall run on diesel. Evidently, the urgency for fuel-efficiency vehicles assume more and more importance considering the necessity of reducing environmental pollution due to diesel exhaust.

It is widely recognized that the existing transport system in Calcutta is both inadequate and incapable of growing at per with the total transit demand unless a provision for alternatives to keep the situation under control is made. Sometimes before, from some corner, the scheme for a circular waterway was advanced to be an optimum alternative, from the view point of cost efficiency. But cost efficiency cannot be the only factor for the transportation system in Calcutta. More important are the factors of environmental pollution, civic health and hygiene. Besides, the link canals so urgently nesessary for such a scheme can never fructify due to litigation for acquisition of lands and structures. Above all, such a circular canal system will multiply the already serious problems of public health and hygiene, and render the environment highly polluted in view of the prevailing social and sanitary practices of the common people as well as mosquito and pathogenic micro-organism menaces. In fact, it will make Calcutta more intolerable for living and ill-effects will be appreciated if a reference is made to the misconception of adopting open cut construction in this city for the Metro railway system.

Calcutta is one of India's Major Port city and it is adjacent to the nation's most valuable natural resources and also possesses a natural base of administrated resilience and a large skilled labour supply. Calcutta to start with was not unplanned. Its initial growth was reasonably looked after by modifications as long as they were not too expensive. But lately, Calcutta is declining fast and its decline is apparent at first glance. And, unless its tragic decline is arrested, who can say if it would live to celebrate its tri-centenary, six years hence. The problems of Calcutta should not, therefore, be considered the responsibility of the state alone. Calcutta's problems are in reality, nation's problems, because of the city's importance to the national econamy. ☐

TRAFFIC PROBLEM IN CALCUTTA

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One of the major factors which beckoned Job Charnock for the third time 1690 to opt for the present site of Calcutta as a permanent British settlement was the presence of a broad communicating road from the river bank to the inland interior. Being primarily a trading centre even during pre-British times, transportation of goods and people was carried across the communicating link mainly on palanquins, animals and animal drawn vehic- e

With the rapid development of Calcutta n a riparian trading post to the agglomer- commercial centre of the East, the existing communicating infrastructures were renovated and additional facilities extended over the adjoining areas of the hinterland.

Increasing business and commercial activities catalysed the influx of various categories of labour over the next 3 centuries from all over the country. Most of them chose to reside and work simultaneously in and around the city, occupying 62% of the present 104 sq. km corporation area and beyond as residential zones and leaving a paltry 6.5% for the movement of pedestrians and traffic. With more and more passenger trips required to transport them to and from their job sites, the city which was originally built for 600,000 to 800,000 to people extended upto 1.5 million, staggered under the additional onslaught of 4.5 to 5 million people, out of which 2.5 to 3 million are non-residents who however use the same public facilities meant for the resident population for an average 26 days a month, 12 to 14 hours a day.

The process of urbanization had meanwhile settled in right after Calcutta wss declared the principal city of the East and the capital city of the British Empire in this direction. Developmental inputs in the form of housing, sanitation, waterworks, markets and activity centres, educational and financial institutions, hospitals and transportation facilities kept pouring in as the population swelled at compound rates of 3.18 to 3.5% per annum over the decades. In no time the principal activity centres and commercial hubs were delineated over the spatial landscape ot the city across the Sealdah-Esplanade-B. B. D. Bag area in the city centre, referred to in planning parlance as the Central Business District (CBD). The river and salt lake swamps acting as deterrents in the west and east respectively, the pattern of city growth took a linear turn across the North-South direction. Commensurately, the population spread across in these 2 directions principally with the spread effect touching the suburban and other areas included within the city conurbation. With economic activities on the rise till the mid sixties of the 20th Century, more and more people arrived in the city in quest of jobs till the population reached a steady inflow figure of 0.75% per annum, ultimately over running all the civic amenities that were created for this influx from time to time. The worst sufferers were sanitation and transportation facilities with an average short fall of 2-2.5 million passenger trips in service supply of the latter, this being reached in the seventies and continuing to worsen during the early eighties (2.5-3).

In effect it could be said that planning for any of public utility services, particularly transport, had not been covered adequately, either from the technological, economic or social point of view. Now that the century is about to set, the trend in planning, effectively for transportation services within and without the city limits, needs to be set on the right track rather than receive temporary, equivocal and ad-hoc renovations. The exact parameters have to be identified before reciprocal developmental measures could be formulated and appropriate planning exercises conducted.

The objective of this paper is to highlight the inadequacies and discrepancies of the existing traffic and transportation planning (TTP) system from the technological, economic and social viewpoint and to outline the proper approach for 2000 AD and beyond on the basis of relevant information, existing and projected.

The Problem : Its causes and impact

A surface transportation system is essentially made up of the following physical components :

(1) the highway, (2) the carrying unit,
(3) the terminal, (4) the motive power.

All TTP exercises have to be conducted in accordance with the interaction of the above components to evolve a technologically compatible system that would be the most effective under the existing spatial and temporal constraints.

The highway

Historical evidence provides us with the information that in 1760 good roads were very few in Calcutta and "the kutcha road that ran to Baraset was the favourite walk of the populace"[1]. Transportation was mainly by the river, both for purposes of commerce and recreation. It was only in 1817 under the Lottery Committee's direction that funds were raised from the public for the reconstruction and modernization of the city, especially its road network. Primary attention was however paid to the development of streets and areas around the British residential quarters in the vicinity of the now Park Street-Wellington Square-College Square-B. B. D. Bag quandrangle. The construction of Strand Road, Amherst Street, Colootola Street and Mirzapur Street was simultaneously carried out. But the metalling of the kutcha roads started in real earnest only since 1820, when provisions for regular watering of the causeways and their annual repairs were directly maintained under the patronage of the Governor-General himself.

One notable feature of these road construction exercises during this era is the establishment of a principal North-South corridor, the Cornwallis Street, which was later remodelled and paved for the laying of tram tracks in 1880. Though mechanised traffic appeared in Calcutta in the late 19th and early 20th century, electrification of tramcars in the year 1900 had necessitated the realignment of certain arteries and corridors for the movement of heavier payload. Mass transportation by motorbuses was started in the year 1920 but road surface conditions did not sufficiently improve in anticipation of either the transit demands of the city or its population which had by then touched the million mark.

The aggregate length of roads constructed within the city, which was 170 miles in 1836 (population 2.2 lakhs) rose to 330 miles in 1888 (population 5.5 lakhs approx.) and finally to 575 miles in 1933-84 with the inclusion of certain municipal areas under the Calcutta Corporation. Whereas in 1876, only 82 miles and 50 miles of the aggregate city road length had been stone-metalled and brick metalled respectively, in 1888, under the Municipal Consolidation Act II (1888), 103 miles and 165 miles were stone and brick metalled[2] bringing the total length of metalled roads to 268 miles (81.2%). In 1983-84 (population 3.5 to 4 million) with an addition of 245 miles of city road length over the past 100 years, the percentage of metalled roads has improved marginally to 85%, whereas not only has the modal composition changed to predominantly mass transit units, pedestrian volume increased 1000% but the total payload composition consisting of intra and inter city passenger trips and cargo overtaken all existing communicating infrastructures and facilities.

That the need for communicating across the Hooghly was a prerequisite for Calcutta's urban development was recognised as early as 1873-74 when the Howrah Floating Bridge was constructed by the Port Commissioners. Later when the traffic volume and composition accelerated over the years, the further river crossings became essential and the first cantilever bridge spanning Howrah with the city was commissioned in 1943 to be followed by the Vivekananda Bridge at Dakshineshwar 12 years later. The inadequacy of the existing bridges is duly reflected by the facts : (1) whereas in 1947, number of vehicles crossing Howrah Bridge (Rabindra Setu) was 12,000 daily in 1966 the figure rose to 43,000 and currently to 1.25 to 1.4 lakhs. (2) The other bridge being outside the metrocore, is generally used by trucks and highwaybound traffic. Being a rail-cum-motorcar bridge with a 2 lane unidirectional flow structure, it is much less effective for passenger vehicles, most of whom prefer to use the Rabindra Setu and the existing northern arteries for West-North origin-destinations additionally to avoid the NH 1 (G. T. Road) traffic across the river.

Albeit, realization of the inadequacies of the existing river crossing facilities had dawned early and plans for two other crossings at the Princep Ghat-Howrah and Kalyani-Bansberia were drawn, lack of initiative from the relevant authorities, paucity of funds technological dependence on non-indegenous sources have reduced all such exercises as cost-prohibitive ventures. The Princep Ghat bridge, scheduled to facilitate trans-river communication from the mid-seventies has yet to function, whilst the cost has escalated from Rs. 60 crores to Rs. 600 crores approximately. The Kalyani-Bansberia crossing, scheduled to connect Kalvani Town with the western half of the CMD and reducing the distance between the town and all locations in the north G. T. Road corridor. principally the Asansol-Durgapur industrial belt has yet to be constructed. All these inadequacies have resulted in unprecedented pressure on the existing Bridges so that bottlenecks and snarls on either side of the river have become a regular phenomenon.

With the receeding draught at the Calcutta port and the planned switch over of cargo handling to Haldia, it was felt that a system of approaches and expressways would augment the existing city arteries to divert oncoming and outgoing cargo traffic from reaching the inner city area. Further, as connecting links between Calcutta and other satellite towns for containing the urban blight in the city and simultaneous dispersal of activities and population over the adjacent areas, these, approaches and expressways were vital planning requirements. Calcutta being already served by a number of national and state highways at its North, East and Western ends, the following system of major streets and highways (Table 1) within the CMD were recommended in the TTP (CMPO 1966) for easing traffic movement within and without the city.

To date, except for a section of the EM Bypass and the Chetla and Kasba overbridges, none of the other projects (Table 1) have been completed though nearly 20 years of planning and construction have elapsed since these were conceived A number of principal corridors and arteries have been widened in the meantime but faulty landuse and illegal encroachment by men and stationery vehicles have considerably reduced their effectiveness. In other cases partial utilization of some of these additional facilities for transportation services have resulted in localized nodal bottlenecks leading to protracted vehicular disalignments across larger areas.

In the absence of any other means of travel excepting the surface transit modes and a sketchy inland water transport network, the paltry surface area become easily congested. To add to the misery 25,000 trucks and nearly 60,000 slow moving passenger and goods vehicle ply bumper to bumper across the same arterial network meant for passenger transit units. Not only is congestion throughout the scheduled routes and desire lines increased but reduced travel velocity and increasing atmospheric pollution through dust and exhaust fumes prolongs travel time and makes city travel a perilous excursion. The absence of ultra-city cargo loading/unloading surface terminals and/or ring-road facilities with feeder roadlinks with the city for trucks to bypass the city limits is keenly felt.

The carrying unit

Even in the penultimate decade of the 20th century, transit modes in Calcutta can be broadly categories into (a) Mechanised units, (b) Non-Mechanised units. Mechanised mass transportation of passenger and goods had been introduced in Calcutta with the total electrification of tramcars by 1904 and the subsequent advent of motor buses run by the Tram Company and Walford Transport Company in the early twenties. Private initiative in the form of individual owners/operators started in 1922 and collectivised into the Bengal Bus Syndicate in 1925. State enterprise started with functioning of the West Bengal State Transport Company in 1948 which was later converted into the Calcutta State Transport Corporation (CSTC) in 1960 under the Road Transport Corporation Act, 1950. In 1966, however, various administrative and financial problems afflicted this Corporation, thus forcing them to handover a number of routes to the private owners. They had been pushed into the background from a near monopolistic vehicular operation owing to the detoriating standards of service, overcrowding conditions on vehicles and increasing risk in travel faced by the commutors, especially during the war and post-war periods when economic activity in and around Calcutta once again intensified, bringing with it an increasing population and the subsequent enhanced travel demand.

Non-mechanised modes had been oper-

TABLE 1. System of Recommended Major Streets & Highways

Project Nos.		Route & Section	Description	Length (km)
1		Princep Ghat Bridge Including immediate approaches—Central Howrah Expressway to Khidderpore Road	6 lane divided	2.88
2		Kalyani Bridge Including immediate approaches	4 lane	—
3		Central Howrah Expressway Princep Ghat Connection to Varanasi Road	4 lane Divided	4.32
4		Kona Expressway Central Howrah Expressway Interchange to NH 6	4 lane Divided	6.88
5		Circular Expressway Park Circus to Belgachhia Road	4 lane Divided	7.20
6		Western Expressway Princep Ghat to Taratolla Road	4 lane Divided	4.80
7		Eastern Metropolitan Bypass	4 lane Divided	
	(a)	Narkeldanga Main Road to A. J. C. Bose Road Connector	—do—	3.2
	(b)	A. J. C. Bose Road to Prince Anwar Shah Road Connector	—do—	4.16
	(c)	Link Road to A. J. C. Bose Road	—do—	1.6
	(d)	Link Road to Hazra Road	4 lane Divided	1.92
	(e)	Link Road to Rash Behari Avenue	—do—	1.6
	(f)	Link Road to Prince Anwar Shah Road	—do—	1.28
	(g)	Link Road to Diamond Harbour Road	—do—	2.4
8		Barrackpore Kalyani Expressway	2 lane	30 24
9		Belghoria Expressway Vivekananda Bridge to Jessore Road	4 lane Divided	7.36
10		G. T. Road Bypass Howrah Municipal Area	4 lane	—
11		Howrah Industrial Highway Kona Expressway to Varanasi Road	4 lane Divided	3.2
12		Chetla and Kasba Overbridges	4 lane Divided	Less than 1 km

ative both as passenger and cargo carriers much before the British settled down in Calcutta. They however brought with them modernized and sophisticated designs of horse drawn vehicles in the form of Phaetons, Victorias, etc. Horse drawn tramcars in 1873 gave a boost to mass transportation since they were strictly non-personalised, with regular routes, schedules, management and fares. The hand pulled rickshaw (HPR) and the Cycle Rickshaw (CR) made their appearances later in 1914 and 1930 respectively as passenger modes though HPR in the 1890's plied as freight carriers. With little or no improvement of road surfaces to suit high velocity mechanised modes, carriages ply even today though operating a dying trade.

Table 2 provides information with respect to the existing urban transportation

TABLE 2 : Modes Constituting Urban Transportation System in Calcutta (1983-84)

	Mode	Approximate year of inception	Fleet strength Total	Fleet strength Effective	Daily Pass. Vol. carried (in million)	% contribution in city transportation
1	Bus (CSTC)	1948	1450	750	1.20	20.06%
2	Bus (Private)	1922	2000	1400	2.75	45.97%
3	Tramcar	1904	400	325	1.00	16.72%
4	Minibus	1972	675	500	0.25	4.18%
5	Taxicab	1906	7500	5000	0.01	0.16%
6	Contract Carriage (including Luxury Taxis)	1965	2100	1800	0.02	0.33%
7	Auto Rickshaw	1983	75	75	—	—
8	Metro Rail (RTS I)	1984 (?)	—	—	—	—
9	Rickshaw					
	HPR	1914	40000	35000	0.75	12.54%
	CR	1930				
10	Hackney Carriage	1730	70	40	—	—

system for purposes of mass and personalised transit[3].

The shortfall in demand as calculated from Table 2 ranges between 2 to 2.5 million on an average working day when the outshedded regular mechanised vehicles are able to complete their scheduled trips. In addition to these modes there are 88,000 private cars, 8000 hand carts, 25000 heavy axle trucks, 6000 light commercial vehicles, bicycles vans and various other non-definable indegenous modes all jostling for the same road space. Consequently traffic snarls and dislocations are rampant in almost all directions whether localised or spreadover, which impedes the flow of the above modes, reduces intracity travel speed to 5-8 kph (Av. speed being 11-15 kph) and increases the shortfall by about 0.5 to 1 million passenger trips during peak/semi-peak hours.

Adding to that is the normal pedestrian flow, processions of various nature, repair and maintenance work conducted on roads and pavements by the different authorities, conservancy staff simultaneously performing their duties, etc. and we have a definite picture of the chaos that prevails in the city on regular working days. Come monsoon and trains and buses on a majority of routes are withdrawn leaving the hapless commutor to the mercies of the residual transportation system or to encounter the hazards of walking across invisible ditches, manholes and abandoned worksites of various developmental authorities which are definitely accident-prone if not fatal.

Taking advantage of this demand shortfall, taxis have long since started plying as 'Shuttle' modes and during peak hours prefer to operate along scheduled routes where passenger occupancy possibilities are high and fares fixed. Thus vis-a-vis metered operation, a taxi carrying 8 to 9 passengers at flat tariff rates stands to maximise profits during a short operational interval across a minimum distance travelled. Likewise contract carriages officially scheduled to perfrom not more than 1 trip a day rampantly violate regulations and ply on scheduled routes at marginally higher tariffs but offer greater passenger comfort and punctuality than the regular mass modes. For this case the anomalies of the stipulated rules promulgated by the State Transport Authorities have forced them to operate unethically since a vehicle costing 4.5 to 5 lakhs cannot afford to remain economically idle throughout the day, especially during tourist offseason times, basing its income on 1 official trip and be expected to offset operational losses throughout the year on tourist chartered trips. When demand for such trips occur, the consumer is faced with daily charges ranging from Rs. 700 to 5000, depending on the demand situation, the occasion and the user's purseload.

Again incidents of such chartered vehicles operating unethically, but with the full knowledge and sometimes connivance of the authorities, on long distance routes has become rather common over the years They take advantage of the demand shortfall on such trips and being solely profit motivated often charge lower than the official carriers but under over-loading conditions. Even inter-State routes are not spared but the common routes where profit probability is the highest are towards North Bengal: Krishnagar, Malda and beyond. Here too, lack of vigilance, corruption and mismanagement of the scheduled modes is the root cause.

The emergence of 'pool-cars' or private cars offering to carry passengers in addition to the owner, on or at common destination points provides a viable alternative for a certain category of office goers. A study executed by the CMPO in 1965-66 revealed a 2.06 passenger-car occupancy ratio for private cars which, spurred on by escalating fuel and maintenance costs, has increased to 3.12 over the next 16 years. Luxury taxis as well as certain private cars operating illegally as 'company' cars or public conveyances have also contributed to enhancing this ratio.

The suburban railways, operating since 1854 and electrified in 1963-64 disgorge 2.7 to 3 lakh passengers daily from the two terminii Sealdah (1.4-1.6 lakhs) and Howrah (1.3-1.4 lakhs) under the Eastern Railway and the Eastern-South Eastern Railways respectively, where the peak arrival period has been recorded as 9 to 10.00 hrs. From 1983, direct rail links between the South and Northern sections of the city and certain areas within and beyond the CMD have been established, which bypasses the Sealdah terminus. Transit time is considerably reduced, overcrowding on city bound trains lowered, costs reduced and possibilities of road-rail link in certain accessible areas of the routes increased. Work on exploration of further possibilities of linking the city peripheral areas with each other while skirting the city limits, ought to continue till enough activities have been generated in those areas to act as sufficient attraction for urbanization and dispersal of population, other factors of production, business and commerce from the supersaturated cosmopolis.

The need for an underground Metro rail was recognised as early as 1949 with further studies on the feasibility of having a Rapid Transit System (RTS) in the city carried out 20 years later in 1969, by the CMPO. As a result the Metropolitan Transport Project/Railways (MTP) was born which recommended the early commencement of work on the first line, 16.43 kms in length from Dum Dum to Tollygunge, touching the principal transit demand generating points of the metrocore, the CBD and ultimately to be extended to Garia, further South, to connect up with the existing Suburban Dispersal line. This route would of course serve the North-South intra-urban traffic and was estimated to carry 1.6 million passengers daily by 1983-84, 1.75 million by 1990 and 1.85 million by 2007 A. D.

Since it has been observed that there exists a strong tendency of city traffic swerving from the North-South arterial roads towards East-West direction, notably towards Sealdah-Howrah agglomeration, the necessity of a second RTS line from Salt Lake town to Ramrajatolla across the CBD was to be given second priority. Because of an estimated 3.5-4 million increase of population in the last decade of the 20th Century and beyond, the RTS was to be further extended by the construction of another North-South metro link connecting Baranagar with Thakurpukur with a main transit interchange point at the Central Station situated at the junction of Chittarajan Avenue and B. B. Ganguly Street. Alternative inter-route crossovers would be effected across alignments on A. J. C. Bose Road, Hazra Road and Rash Behari Avenue respectively. Ultimately there would be 5 RTS alignment across the city covering a total length of 97.5 kms, scheduled to be completed according to the plans by 2010 A. D.

A few unpleasant facts have however reared their urgly heads over the planners' optimism regarding the inception and continuation of the RTS in Calcutta :

(1) The first line between Dum Dum and Tollygunge, scheduled to operate in 1978 and to cost Rs. 140 crores, has had to face repeated revisioning of cost estimates and commencement schedules over the years. The delay in commissioning of the route has seriously affected intracity traffic movement and accessibility bringing total and partial transit dislocations in the principal and detour arteries, not to mention the additional burden on the Exchequer to the tune of Rs. 600 crores (1980-81) and finally to the awesome figure of Rs. 1000 crores when the first RTS coach is expected to ply on the route (1986-87). The year of commencement has been finally revised to 1984-85 for partial movement and 1986-87 for total movement.

(2) As the cost of carrying a single unit on the RTS has been earlier worked out as Rs. 0.132 and Rs. 0.32 was considered to be break-even fare level, the fare level recommended at that time was Rs. 0.30 per passenger, which would necessitate a subsidy of nearly Rs. 10 million/annum. In 1979-80, with the target year as 1983, the fare level recommended was Rs. 0.50 per passenger. For 1982-83, the target year having shifted to 1986-87, the revised fare level stands at Rs. 1.00 on a flat basis and Rs. 1.60 if the Central Government charges 6% interest on the capital. The surcharge on route interchange trips fixed initially at Rs. 0.20 may be revised to Rs. 0.50 so that North-East or South-West travel may cost Rs. 1.50 in one direction. This revision also takes into account revenue leakage in different existing forms since it has been found out that almost all mass transit modes are faced with this malady. The leakage figures have been estimated as :

Trams – 10%-12%
CSTC Buses–15%-20%
Private Buses – 12%-15%
Suburban Trains–20%-25%.

(3) According to MTP estimates, 374 RTS units (each way) were destined to carry 1.53 million passengers in 1983, with a peak hour volume of 60,000 ; 429 RTS units to carry 1.73 million in 1990 with a peak figure of 67,000. Since by this period the total intracity transit trips would have reached the 10 million mark with the population rising at a steady 0.75% per annum, the anticipated modal frequency, velocity and total outshedded units would have to function at peak capacity levels if they are to serve the escalating transit need meaningfully. The metro which is unlikely to function fully before 1986-87 will have to bear an estimated 3-3.5 million passenger volumes whereas its capacity will be geared to take at the most 1.0 to 1.2 million. If the present tactics of procastination and unco-ordinated management are to continue, one shudders to think of the situation beyond 2000 A. D.

Another important aspect which has been overlooked in almost all planning levels is the complementarity of the RTS with the existing and future surface modes. The majority of the route length outlined for RTS I passes through the CBD. Whereas, the population density of the Calcutta Business District (CBD) in 1971 was 64,608 persons/sq. km and that of the inner core 1,24,511/sq km, passengers entering/leaving the CBD between 8.00-20.00 hrs in 1982-83 have been recorded as 1.5 million/day. With no signs of abatement of commercial and business activities in and around the CBD which has generated a centripetal human force towards the inner core; by 2010 AD, the daily CBD influx may well touch the present population figure of the entire metropolis, with more areas and arteries falling under the extended CBD. Unless the RTS acts in co-ordination with the surface mass transit modes, the erupting fountain of passengers from the respective RTS terminii would not only create traffic dislocations within the CBD but vehicular and pedestrian movement would be seriously hampered throughout the RTS route and beyond. Suitable footwalls, subways, footbridges, etc., would have to be made available for pedestrian movement along with proper street management, signalling, illumination, speed control, grade separated movement and other infrastructures suitable for smooth vehicular flow. Special attention has to be paid to the movement of surface MTM, not only through optimal route reallocations but also making them convenient for exiting RTS passengers at physically appropriate and economically viable intervals.

(4) The Rs. 1,000 crore investment on a single line of the RTS has scared away the authorities from further capital expenditure on the subsequent routes It is disheartening to note that lack of proper management and timely execution chiefly due to paucity of funds and ignorance of physical, demographic and financial contingencies has been the root cause behind such a decision, if at all it is seriously considered. Not only are the 2 other RTS lines a priority requisite for intra-urban transit, but an absolute necessity for future activity dispersal and spatial integration of urban and non-urban areas of the hinterland beyond 2000 A. D.

While concentrating on transit systems integration, Calcutta's need for systems other than surface units have to be stressed. Mention may be made of the proposed circular railway system that skirts the metrocore and the developing and newly urbanized areas of the metropolis and beyond. As it is not the objective of the paper to question the technical feasibility of the MTP plans which have overruled the construction of Elevated Railtracks in the heart of of Calcutta[4] the need to augment the existing and future surface modal supply with other than surface modes is a priority plan assignment. Instead of debating endlessly on mere administrative trivialities, the planners, administrators and executors should effectuate maximum co-operation in making the project a success, before escalating costs, accelerating transit demand and modal saturation ruin its chances of complementary operations.

Insufficent exploitation of Calcutta's waterways has deprived the city of yet another mode of intra urban mass transportation. A synthetic origin-destination study carried out in 1970-71 revealed that "Calcutta corporation area, together with its contiguous areas on the East-bank side of the Hooghly accounted for 85% of total transit trip ends, while Howrah Municipal area accounted for the remaining 15%. The CBD alone accounted for 19%, the Southern part of the city accessible by waterways for 20% and the northern part by another 9%[5]. In 1975 an estimated 17,000 people were ferried to different destinations daily from Chandpal Ghat between 6.00 and 19.00 hrs. In 1983 this figure has nearly trebled illustrating the increasing acceptance of this mode of travel by the population. The percentage figures above clearly indicate that potentialities have not been realized to the full and more routes, greater operational frequency, increased modal capacity and fleet strength have to be augmented in the very near future along with adequate studies on transit demand, rationalization of existing and future route network conducted on the planning level.

The terminal

The paucity of adequate pedestrian ways, parking and nodal termini has added to the transit chaos of the city in no uncertain terms. Though metalling of roads had started by 1821, the first footpath constructed of brick-on-edge by filling up an open drain on the east of Chowringhee Road was built in 1858. Today pavements are almost non-existent, thanks to the indiscriminate and illegal business and developmental activities carried out on the remaining few, forcing the pedestrians to jaywalk across busy streets and intersections. Figures reveal that about 50% of the persons killed on roads in many cities are pedestrians and are mainly due to the absense or disuse of facilities for pedestrian segregation. The 21st Century should be reminded that a pedestrian is a 'traffic unit' and any transportation plan designed without adequate pedestrian facilities is incomplete[6].

Although a number of studies on parking facilities have been conducted, since, parking of vehicles on or off the main arteries continues to pose a serious traffic problem. Expectedly, the CBD is the principal focus where major parking deficiencies continue to occur. With the vehicle population in the city rising by 80% during 1973-83, the problem of parking the stock without interferring with vehicle flow is becoming more acute. In the CBD itself, 81% of the total parking space is occupied by kerbside parking with the remaining 19% used for off-street parking. Between 11.00 and 17.00 hours nearly 100% of the kerbside and 95% of the off street facilities are utilized and double-parking on some of these arteries have become a regular feature, adding to the existing congestion and throwing the entire areal movement into disarray. The misery is accentuated by the fact that almost everyone wants to park his vehicle as near his destination as physically possible even if it results in partial road blocade.

Many solutions have been offered since but to marginal effect. For private vehicles the parking fee of Rs. 0.60/hour does not evoke much response since revenue leakage is rampant or a fixed amount 'arrainged' with the parking attendant. Solutions offering underground, inhouse, multi-level, etc., parking facilities have either been ignored or are physically impossible. Parking within the CBD core has to be stopped at any cost by using the harshest coercive measures possible and more powers designated to the vigilance and control squads to stop this menance. Because of the absence of marked bus stops and taxi stands in most areas of the city, these MTM pick up and disembark passengers at whatever point they choose. In the absence of vigilance and penalizing rules their actions go virtually unchecked and traffic flow is either unnecessarily brought to a halt or thrown out of gear. The education of the public service vehicle (PSV) operators is incomplete unless they learn to drive in a more complementary than competitive spirit.

The 21st Century would witness a total vehicular transit paralysis unless activities in and around the CBD are disbursed across the projected urban areas and satellite zones. The construction of expressways, flyovers, humps and their approaches are made to dispel polarized congestion and increase intra-urban travel speed not to provide additional parking space for shoppers, office-goers and other travellers. Parking spaces along the alignments of the newly constructed roads may well provide short term solutions but long term measures must include among others heavy tariffs for core area parking, more sophisticated facilities for offstreet parking, construction of safe and encroachment free pedestrian walkways and heavier penalty for offenders.

The presence of wayside terminals for certain Mass Transit Mode (MTM) has a considerable retarding impact on the vehicular flow pattern. Long term measures must envisage offstreet parking for such modes, especially during peak hours. Construction of Depots and garages for housing stationary modes should involve State cooperation where public MTM are concerned.

The importance of Calcutta, the presence of the Port and the nearness of 4 National Highways has brought about tremendous pressure through truck movements on the streets and traffic of Calcutta. There are more than 450 trucking companies, transport agents and Contractors operating right from within the city centre with loading and unloading activities continuing throughout the day. Almost 90% of these companies are located within the CBD but 37% of these have garaging facilities within the city[7]. With economic activities on the rise, trucking activities are expected to show a minimum increase of 30% over the next 3 decades, especially with the construction of additional road space and river crossing facilities.

Two major truck terminals with a covering area of 500 acres each, have been on the planning charts since 1966-67. The West side terminal at Kona is under construction while the East side terminal near Park Circus having direct access from the EM Bypass is scheduled for completion by the turn of this century. Will these 2 terminals be sufficient to contain the inflow of trucks into Calcutta ? Since the major problem lies with the cargo movement and not the movers, the construction of suitable facilities for the cargo to be conveyed to the required destination would provide a more optimistic answer. The use of light commercial vehicles for such purposes is a favourable suggestion since they occupy less space, are more manoevreable and offer speedier service. Moreover, road repair and maintenance costs would be considerably curbed in the absence of heavy tonnage vehicles.

However one cannot refrain from pointing out that all such urban planning exercises are being conducted with Calcutta as the focal centre and iurface travel the sole means of transportation. Long term policy should envisage the use of other urban areas and satellite towns as suitable commercial centres but for that suitable urban infrastructural facilities have to be provided before the entrepreneurs take serious notice of fresher pastures. The topography of the State is such that riverine transportation could be plentifully availed of and freight transport by roads within the conurbation and beyond can be substituted considerably by inland water transportation using small and medium size vessels. Thus in the long run truck terminals could be situated even further away from Calcutta, thus drawing away the activities involving domestic cargo handling from the city limits and the ensuring habitation that surrounds such activities.

The motive power

The use of electricity for mechanized mass transportation in 1900 was followed by the use of oil as the energy source since 1920. Diesel operated buses were brought in as late as 1948 and with the gradual conversion of all heavy duty engines from petrol to this substitute, by the late fifties the transformation was near complete. Electricity, however, continued to remain as a power source used by tram cars even though all other metropolitan cities in India had abandoned them by the sixties. It was mentioned when the question of withdrawing trams from the city was mooted that electricity was cheap, efficient and left no pollutants in the atmosphere. Later as oil prices rose sharply over the years and a global crisis ensued from the diminishing oil reserves, electricity continued to gain patronage from transportation planners all over the world and Calcutta planners responded by extending tram services on a number of new routes. Current projects being implemented are the extension of tramcars to Salt Lake via Maniktala Main Road and to Dunlop Bridge via B. T. Road. For future execution following plans have been approved :

(1) Extensions upto Joka* via Diamond Harbour Road.

(2) Connecting Monali with Park Circus via C. I. T. Road.

(3) Connecting Jadavpur with Tollygunge via Prince Anwar Shah Road.

Though the present electricity generation in the State is running at a deficit, electric power continues to be a cheap source of energy especially since it does not depend on any particular resource input and can be recycled and harnessed in various ways. Research and Development departments of relevant industries all over the world are busy exploring alternate energy sources and developing low input-high output energy conversion machinery for more efficient, varied and advantageous future use including transportation.

Simultaneously fuel efficient passenger vehicles are being designed and the newly introduced petrol driven Auto-rickshaw in Calcutta may by 2000 AD be replaced by a diesel powered engine, the prototype of which has been offered for sale at a consumer price of Rs. 35,000.

Whatever be the source of energy used, the transport planner must keep in mind the fundamental objective of providing the urban commutors with a safe, efficient and economically viable system that can function competently under the existing and future constraints, technological, economic and social.

Summary of observations

To date the major problems afflicting the traffic and transportation system of Calcutta may be summarily categorized as :

(1) an inadequate road network system with 4.5-5% of city roadspace being actually effective ;

(2) the presence of too many intersection points across straight stretches of principal corridors and maximum vehicular use of all these intersections in the absence of adequate signal and control facilities (936 principal intersection points within the city with only 215 being manually or mechanically controlled) ;

(3) an insufficient surface modal system that is grossly overworked and operates more in competition than co-ordination ;

(4) the absense of adequate river crossing facilities that has helped containment of most economic activities across the linear trajectory of the city boundary, particularly within the CBD ;

(5) simultaneous movement of slow moving vehicles across the city arteries ;

(6) absense of ring road, truck terminals and ultra-city parking facilities for trucks and heavy duty vehicles which force them to use the existing city road network and time ;

(7) dearth of parking spaces and terminal facilities for the city surface modes ;

(8) insufficient pedestrian ways and crossovers that have further induced congestion, retardation of intra-urban vehicular velocity and accidents ;

(9) the existence of a temporal classification of orthodox peak and off-peak hours which over utilizes the transportation system and road network for the regularized peak periods and induces unorthodox traffic movement during off-peak periods ;

(10) concentration of principal activity centres in and around the CBD which induces simultaneous pedestrian, cargo, vehicular and tertiary sector activities in localized pockets ;

(11) too much emphasis on surface transit and minimum use of existing riverine and inland water network.

Suggestions and conclusion

What are the new plan strategies to be adopted to save Calcutta and its conurbation from unretracable urban detoriation, particularly of its Traffic & Transportation facilities, a reality which is inevitable by 2000 AD, give or take a few years, under the existing planning system ?

The execution of plans is not as simple as the planning itself. In recognition of the above fact a few suggestions have been offered which may not change the face of Calcutta overnight but would surely go a long way in helping the city to recover from further blight :

(1) Future plan strategies should primarily emphasize the benefits of long term planning rather than short run or ad-hoc measures which have a feedback effect on the

entire system and hinder further development one way or the other.

(2) Traffic and Transportation planning should not include only the technological aspects but give equal emphasis to the economic and social attributes of the long term planning function. As a public utility, good passenger transportation plans and policies must play primary importance on the significance and value of user demand and benefit. Operational and infrastructural costs and overheads should not be placed entirely on the user's shoulder and subsequent public funds but possibilities of exploring other revenue outlets for meeting such expenditures must be contained in the planning framework. Speculative deals on area development at the Government's initiative to be ultimately used for public welfare is one such long term measure. As an example, the area surrounding the RTS route network could be developed by the state to enhance more urban facilities for local and zonal use while the proceeds from the sale of some of these facilities could be recycled to generate additional facilities, transportation being one of those.

(3) Physical planning should not concentrate on the construction of road dividers and speed breakers alone. These are extremely temporary measures and with the anticipated passenger and traffic volumes beyond 2000 AD, will do more harm than good by placing unnecessary obstructions to vehicle manoeuvrability and speed, factors which are vital for future high velocity movement. Rather alternative strategies in the form of increased road space, removal of pavement encroachments, grade separated transit movement, stricter street discipline, better illumination and signalling have to be adopted.

(4) The Modal mix in the city is far too heterogenous for streamlined and efficient travel. The introduction on more personalized limited-capacity public modes would further jeopardize the situation. The transit trip deficit over the years cannot be met by increasing modal supply in an arbitrary manner. Since the construction of suitable infrastructures for handling heavy traffic volume over limited space incurs considerably higher costs than vehicle procurement, rationalization of existing passenger routes in a more demand and desire line oriented manner would not only reduce the transit deficit but would also cut down operational losses of the relevant modes.

Long term modal stratagies should place more emphasis on mass movement of passengers rather than encourage intracity personalized travel. Only a highly developed and efficient public transit service can reduce the inertia of increasing personalized trips to the city centre and other principal activity spots.

(5) Traffic plans projected beyond 2000 AD should envisage the total banishment of trucks, heavy duty cargo carriers and slow moving vehicles from the city. Encouragement to light commercial vehicle owners and other non-bulk operators should be one of the administrative prerogatives aimed at improving the city's mobility. Stricter vigilance by the traffic control authorities can fully ensure the total stop to all truck movements within the city, except for conservancy and emergency purposes. Even then, time regulation of truck movements for conservancy or constructional activities must be coerced in the wider interests of society. Along with the construction of truck terminals, increased use of river transportation for cargo movement should be encouraged both as substitute and complementary measures.

(6) Working in co-ordination with Commercial and Business establishments in the CBD and particularly within the core area, office hours should be spread out so that peaks are more spaced than concentric and modal movement and co-ordination more streamlined.

(7) Abandonment of further RTS projects would only encourage surface movement which would surely choke the remaining surface area and gradually gobble up the additional space created. Long term policies

should contain more strategies for utilization of the existing river and canal (13 kms) facilities surrounding Calcutta since these are natural advantages the city is endowed with. Concomittant exercises on sewage disposal, sanitation, etc., should also continue keeping in view the air and surface pollution factor.

(8) Electricity as a future energy source for mass transit should be given prime importance in the absence of suitable fuel alternatives. Rational planning cannot as yet concieve the use of cost-prohibitive solar energy, though bio-gas hydrogen, alcohol and its byproducts could be considered as motive power sources in the near future.

(9) Finally, the planner must realize that any long term planning for Calcutta must be conceived at points away from Calcutta. Unless alternate sites such as Kalyani, Dankuni, Salt Lake city, etc are developed with adequate infrastructural facilities, the attraction towards Calcutta would always remain. Unless economic activities are spread over the adjacent hinterland area, no amount of traffic and transportation planning can save Calcutta. Calcutta may be conceived as some sort of Operational Headquarters with only the essential administrative, educational, health, recreational, etc. services remaining, but it can no longer remain as the job site for the forthcoming 10 million population by 2010 AD and beyond. In this connection more river crossing facilities would surely help as in the case of other leading Metropolises of the world. Underground crossover facilities should not be ignored since the technology is readily available.

In retrospect it could be mentioned that this paper hints very broadly on overall regional development rather than isolated planning activities. Unless a suitable backup transportation system is created spreading accross the entire region, and having trip ends beyond the metropolis and particularly the core area, long term measures alone will not ensure the desired level of success. All approaches to planning today should concentrate on the urgency of an effective interaction between the land use and transportation planning of an urban complex which is subsequently co-related to the development matrix of the connected[8]. The arguments placed for consideration here repeatedly point out the inadequacy of short term measures that have been applied intermittently on the urban travel system and the resultant chaos. The 21st Century should witness an integrated planning effort towards systems development not only for the benefit of Calcuttans but the entire region as well. One hopes that the level of optimism is supported by credible plans and appropriate policies. ☐

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IV. HEALTH AND ENVIRONMENTAL HYGIENE

KNOWN AND UNKNOWN OF FUTURE, PARTICULARLY OF CALCUTTA*

(Key-note Address)

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ALMOST eight years before (April 1976), Indian Chamber of Commerce, Calcutta, organised a conference on Calcutta 2000—Some Imperatives for Action Now. Deliberations and discussions, followed by recommendation adoption for imperative action and its transmittal to concerned authorities were amply undertaken. It is presumed that out of the said deliberation only a little has been done or attempted so far and there remains much to be achieved for the satisfaction of many.

Now we are all here at the Bose Institute, Calcutta, to attend the seminar on Calcutta Beyond 2000 AD. Whereas in the former, time target was visualised for shape of things to come in 2000 AD with imperative actions to combat the undercurrents and evils out of human actions; in contrast to this the present seminar goes a little further and enters into the 21st century. In the total time frame of the earth's life, it really matters little whether we are concerned for 2000 AD or beyond. What is probably more important is that we propose to discuss and visualise the shape of things to come in future, which one may term as futurology. Undoubtedly futurology is a complex study and a number of people have started pondering over it so that the planet Earth may be used by the generation yet unborn.

It will be my endeavour to put forward some salient points for consideration of this august gathering on "Known and unknown of future, particularly of Calcutta". At this stage, let me admit frankly that the opinion expressed here are purely my personal and it does not reflect any official and non-official views of the R & D Institute to which I belong. Furthermore, in presenting various data, models and information I have borrowed heavily from various published sources—particularly from the Global 2000 Report (to the President of the US), and other sources and to this I will blend my own experience and intuition, often recklessly, to understand and to exchange ideas about the shape of things to come beyond 2000 AD.

Known of the Unknown Future

In any critical projection for future, adequate *base level data* of the past and present are essentially a must. Needless to mention that such data must also be reliable and statistically valid. First question that emerges now : do we have sufficient reliable data and information ? My own view on this aspect is that either we do not have much data or we have scattered data (which although are valuable & valid) recorded in office files and archives only and are not easily available for interpretation. This is possibly valid not only in health and environmental hygiene sector but also in other spheres of activities such as housing, traffic and transportation, education and communication, etc.

The other point that is relevant to reckon is that can Calcutta do it alone ? Should it not be the concern of the country as such in its totality in preference to Calcutta alone ? I am sure that many of you will opt for the latter than the former. Nevertheless, it is useful to keep a watchful eye on Calcutta for it is possibly the weakest link in the would-be chain of Urban Megapolis of India during 21st century.

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* Based on the recorded version of a speech delivered by the author in the Seminar on Calcutta Beyond 2000 AD.

Known Analysis from Various Global Models

As thing stands to-day, it is known that so far much concern has been expressed about things to happen in 21st century or at the fag end of 20th century. Different study groups have attempted in their own way to give multiferous input. None of these models are without any limitations inspite of massive data analysis and incorporation. Yet some model are most optimistic on real value analysis than the other. For general insight, it will not be out of place to mention here briefly a few of these models which have been the subject matter of world wide attention. These World Models are :

(i) Mesarovic—Pestel World Model ;
(ii) Model of International Relations in Agriculture (MOIRA) ;
(iii) The Latin American World Model ;
(iv) U. N. World Model ;
(v) Aurelio Peccei's Worlds 2 and 3 ;
(vi) Global 2000 Model.

The Latin American Model (Barrelochi Model)

Of the six models, the Latin American World Model is considered to be most optimistic. As analysed by the experts, it is apparent that the Latin American Model addressed themselves to the question : "How can global resources be used best to meet basic human needs for all people ?". This model allocates labour and capital to maximise life expectancy and pay little attention to project the future on the basis of policies and current trends. Furthermore, it assumes that personal consumption is sacrifices to maintain very high investment rates, and it sets firmly an egalitarian, non-exploitable, wisely managed world society that forces least environmental degradation. Even with this idealistic situation, the Latin American World Model finds out that in little more than one generation basic human needs could be adequately satisfied in Latin America and in Africa. But the Asian prospect is somewhat bleak. According to this model, beginning around the first decade of 21st century (2010) food crisis in Asia accentuates for reason of abnormal population growth and non-availability of agricultural land. This will lead to starvation and economic collapse by mid-century (2050). As a workable solution to such catastropic situation the modelers suggest that the food crisis in Asian countries could be avoided by such means as food imports from other surplus areas with more crop land, better agricultural yield, and effective family planning policies. Nonetheless, it is meaningful to note that this model which is designed to show that the fundamental constraints on human welfare were social, not physical, does project catastrophic food shortages in Asia due to land scarcity.

Even in the best fit condition from Asian scenario, Indian condition—it seems—need careful and constant nurturing from now onwards, if the Latin American World Model is accepted in its true spirit by the modern Indian Planners.

The Club of Rome Pattern Models

Aurelio Peccei's the World 2 and World 3 models were the basis of the Club of Rome Report entitled The Limits of Growth which gave considerable attention on trends in (i) population, (ii) environment and (iii) natural resources but ignored sizeably the regional differences and looked to the world as a whole. Subsequently, as a modification or updating world 2 and world 3 models the Club of Rome took effort to put forward the World Integrated Model (WIM) taking adequately into account the inadequacies of regional differences, trade, economics and shifts from one energy source to another, but with lesser degree of treatment on environmental issues. At the conclusion, this model indicates that even under a wide range of policies and conditions massive famine in Asia and, to a lesser degree in non-OPEC Africa is inevitable by the turn of this century.

The UN World Model

The UN world model sets for an "input & output" view of the world economy as postulated by Wassily Leontief, who was subsequently awarded Nobel Prize in economics in 1973. Critical analysis of the model reveals that economic prospects for the Less Developed Countries (LDCs) are not in general optimistic. Low level of consumption for private use and investment ratios of unprecedented nature would have to be maintained to keep the postulated target growth rate for many of the developing countries. It is given that by 2000 AD none of the developing region would have a level of personal consumption in excess of 63 per cent of income, and none would have a level of private investment of less than 20 per cent. Curiously enough for many of the low income Asian and Latin American countries the agricultural output have no increase by more than 500 per cent. Except Lead and Zinc, other geological resources (Copper, Bauxite, Nickel, Iron, Coal, Natural Gas and Crude Petroleum) are not in the run to be used up by 2000 AD. There is a school amongst experts, mostly western, who believe that the poor nations of the world are harbouring under misconception that growth would eventually extricate them from their poverty and to these groups of experts UN World Model is a compromise.

MOIRA Model

This model treats mostly on agricultural components and predicts a rather optimistic view of the World Food Production. Because of increased production, a 36% rise in per capita food consumption is contemplated. In this model, environmental degradation is not considered as a serious component and this causes concern to many of the other groups, who believe that for a better quality of life, the arrest of environmental degradation is a necessarily must.

US Government World Model of 2000 AD

The US Government Global Report 2000 was conceived in May 1977 and is considered as a latest model report. Object of this study was to lay foundation of long term planning based on probable changes in the world's population, natural resources and environment through the end of 2000 AD. Obviously, for this reason the projections of this report stop at the year 2000 and does not foresee the most dramatic developments projected in other studies, wherein it is shown that damages start to be felt in the first half of the 21st century. Damages relate to serious resource scarties, rising death rate, undue environmental disruption, etc. Nevertheless, the findings of the report are startling and need to be reckoned in its totality. This report does not spell out the doom but projects what would be the world conditions that could develop eventually on two basic assumptions :

(1) Continuation of rapid rates of technological advance ; and

(2) Continuation of present public policy of institutions.

The chapter dealing with major findings and conclusion goes to state as follows :

"If the present trend continues, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now. Serious stresses involving population, resources, and environment are clearly visible ahead. Despite greater national output, the world's people will be poorer in many ways than they are today.

For hundreds of millions of the desperately poor, the outlook for food and other necessities of life will be no better. For many it will be worse. Baring revolutionary advances in technology, life for most people on earth will be more precarious in 2000 than it is now—unless the nations of the world act decisively to alter current trends.

This in essence, is the picture emerging from the study of US Government World Model of 2000 AD. They do not predict what will happen. Rather, they depict conditions that are likely to develop if there are no changes in public policies, institutions or rates of technological advances, and if there are no wars or other major disruptions. A keener awarness of the nature of the current trends, however, may induce changes that will alter these trends and the projected outcome.

In the preceeding paragraphs, I have tried to project the facts as available from various studies, which were for all intent and purpose useful and scientific. What lessons could we—in developing countries—take? Neither we are keen to be eradicated owing to the strain of population growth, resource scarcity or environmental degradation nor we can shut down our eyes to the projected views of the various World Models. Needless to mention that we abhor war and other natural disaster as this is neither in our temparament nor we can withstand it with delicate frame of economy. The real answer would possibly then be within the framework of (1) value orientation to bring about changes in public policies, institutions, etc. and also (2) to go in for revolutionary technological advances for which India as a country is reported to have immense potentialities. It remains to be seen, however, if this will be done or not.

Calcutta's cry for unknown future

In our individual life and corporate life one may venture to form some idea about future if the past and present are throughly known, and corrective measures are taken to eradicate the gaps, inadequacies and disproportions.

Let me take one example, about the environment of Calcutta. Air pollution of calcutta has recently drawn some attention of public and private organisations. As a project leader of NEERI Team who conducted classical and yet systematic study spread over a period of a decade (1972-81) on air quality monitoring in the twin cities of Calcutta and Howrah, I would like to state that Calcutta has by now built-up a sizeable data on which a modest beginning can be made to adopt control measures and other relevant steps on air pollution.

Very briefly, I would project a few salient points on levels of various air pollutants in the twin cities of Calcutta and Howrah.

To enumerate the situation, consider for example, a snap data of 1973-75. It goes to show the following :

(1) The total emission in the region is of the order of 671 metric tonnes per day (MTPD) constituting the following pollutants:

(a) Suspended Particulates of Matter (SPM) (286 MTPD)—43%

(b) Gaseous pollutants (385 MTPD)—57%
  (i) Carbon monoxide (214 MTPD)—32%
  (ii) Hydrocarbons (69 MTPD)—10%
  (iii) Sulphur dioxide (59 MTPD)—9%
  (iv) Oxides of nitrogen (43 MTPD)—6%.

(2) Suspended particulates are being released, namely from industries using coal (262 MTPD) and from domestic coal burning (16 MTPD).

(3) Sulphur dioxide concentration reach a peak value during winter wherein seasonal average recorded is 70 $\mu g/m^3$ on account of stable meteorological conditions, resulting in temperature inversion.

(4) Industrial emissions contribute about 27 MTPD of SO_x, transport contributes an equal amount and domestic coal burning about 6 MTPD.

(5) CO, HC and NO_x are mainly released by vehicular sources which is aggravated by poor engine condition and traffic jams.

Before I conclude I would like to dilate on one or two other points.

What are basic human needs ? there can not be any short reply to this. Nevertheless (in tune with Johan Galtung) it may not be out of place to suggest that security, welfare, freedom and identity are four classes of basic human needs that most homo sapiens care for. And for many, economic welfare in terms of basic satisfiers—like food, shelter, clothes, medical service, education are the top needs.

Then again, we often hear about the "Quality of Life". I would imagine that this calls for a precise definition and to integrate the same component vis-a-vis environmental degradation aspect for an overall planning for West Bengal beyond 2000 AD. In the same manner, other states should also make similar exercises based on real value data for an overall look into the period beyond 2000 AD. May I remind that we can not live in isolation and a livable Calcutta beyond 2000 AD is just not enough for the whole country. Growth should be overall for the entire country and then only, the fruits of labour will reach the masses. Calcutta, being a metropolis now, will be a megapolis by the 1st quarters of 21st century and should be able to draw its due share of importance in the entire planning processes of the state and country. It is my personal feeling that in such exercises for our country or state beyond 2000 AD, it would be rational if all the basic needs are given its due priorities. That is to say, all the four classes of needs are to be considered "in conjunction". It is not intended that we should first work with one item, then the other and then the third. The task is to tackle them all at the same time. It is a difficult proposition but not an unsurmounable one in the context of present socio-economic set-up. And to do this, extreme value orientation and revolutionary technological advances will be called for. ☐

HEALTH PROSPECT OF THE PEOPLE OF CALCUTTA

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IT was at Alma-ata in 1977, custodians of health of various countries met under the auspices of World Health Organisation and took the pledge to offer "Health for All by 2000 A. D.". India was also a signatory to this declaration.

It was further decided that count down for achievement of the object would start from 1980. Four years have passed away and we have sixteen years left for implementation of the programme.

Problems of each country are not similar and it can not be so. Affluent countries have already been able to control almost all communicable diseases and have provided basic health facilities to the people of their countries. Their problems today are mainly cardiovascular diseases, metabolic diseases and disorders of mental health. Whereas problems of the under-developed and developing countries are various infectious diseases and disorders due to nutritional deficiencies.

So far our country is concerned, apart from problems as stated above, we have other problems also, and that is population explosion.

There is no denial of the fact that since we achieved our independence in 1947, there have been tremendous increase in food production, agriculture output, housing and other resources, but that is not apparent because of increase in population to almost double.

Even thirty five years after independence majority of our people are living below the poverty line and the health problems of the poor are different. Many of them suffer from subnutrition and malnutrition, various forms of communicable diseases mostly due to bad housing and hygiene, bad water and diseases due to polluted environment. Many of our people are also slaves of addictions. There is no distinction between the rich and poor so far addictions are concerned.

To bring positive "Health for All by 2000 A. D.", specially for Calcuttans, we have to find out solutions to the problems. The most important Problems are—

(1) To have healthy homes for the people.

(2) Safe water supply which would bring down water borne diseases.

(3) To eliminate possible breeding places of flies and mosquitoes. Where it is not possible, spray of insectisides in a regular manner so that vector borne diseases may be minimized.

(4) To provide balanced food for those who cannot procure it.

(5) Preventive vaccination and inoculation against preventable diseases.

(6) To have clean environment in and around the city.

When we analyse the problems and try to find out solutions, we realize how difficult it is to achieve the object. Taking up the problems one by one, it would appear impossible to have homes for all in the city ; not to speak of healthy homes. Population is swelling up every day, babies are born, people flock into the city from villages or other States in search of a job. To provide living space for all people is an impossible task, unless we put a halt to the influx. Thousands of slum dwellers live in a condition which is not even suitable for habitation of animals. These people, due to bad and unhygienic living condition are vulnerable objects to various respiratory and gastrointestinal disorders.

Hundreds of people are seen to live on the footpaths with open sky over their head. They live there, multiply there and also die on the pavements. These people have various occupations, some of them trade on dirt and filth, for which they are perpetual sufferers of ill health. The children in this community are always under-nourished and frequently suffer from worm infestation in the intestines.

Water supply is a big problem in our city. There is persistant shortage of filtered water supply. But where we suffer from inadequate filtered water supply, one often sees wastage of filtered water from road side taps. Why this paradoxical position ? Because the stoppers are stolen by unscrupulous people, who earn their food by selling those to more dishonest people and national criminals who in turn melt those stolen goods in their melting shops.

If one goes to the canal side in eastern part of the city from Beliaghata to Belgachia, or to the Adi-Ganga in the Kalighat area in the south western part of the city one will have a shocking experience of the sight that how people have built up shelters on the canal bank. Their excreta and refuge of their domestic animals (goats, pigs, ducks, hens, etc.) drains into the canal water. This water is again used by those unfortunate people for their domestic use. What a horrible situation.

The Bhagirathi flows along the west of the city of Calcutta. In the upstream, factory refuge are thrown into the river without any treatment. As a result, the river water is a source of danger even for those who bath in it. To have a practical experience one may go to see our burning ghats on the river bank. To me it appears that there is no dirtier cremation spots in our city than the burning ghats.

There are many khatals in and around the suburbs of the city ; these are invariably most. unhygienic spots. Garbage are not regularly removed and allowed to accumulat on important roads, even in the hospital campus. These places, canals in and around city, open drains in the suburbs are good breeding places for flies and mosquitoes. Diseases that are produced by mosquitoes need not require elaboration.

Nutrition is another big problem. In our country a section of the people suffer due to overfeeding and another very large section are underfed and are deprived of balanced food. Naturally they suffer from subnutrition and malnutrition. One need not search for these cases in hospitals ; they are around you, on your street, on the footpath, you can see their dry brittle skin, lustureless scanty hair, with ulcer at the angle of the mouth.

These are all features of vitamin deficiency. Incidentally, you are probably aware that our pharmaceutical industry produce large quantity of finished product containing vitamins. But those who take vitamins most of them do not need it ; and those who really need vitamins they do not get it. This is really an abuse of drug.

The problem of proper nourishment will continue to remain a difficult task, unless we can step up food production for new mouths that are being born every minute. This is impossible ; because land has a limit for production.

We may achieve some success in vaccination programme ; provided the persons entrusted for this job are honest, sincere and dutiful. But unfortunately very rarely such persons are available.

And lastly, environment in the city are getting bad to worse every day. Apart from those factors already mentioned, smoke nuisance is making the air polluted. Smoke is produced in factories in and around the city ; vehicular traffic are also largely responsible. Now in big establishments generators are being used due to power failure. In the slums, cooking ovens also share in air pollution by smoke produced by them.

Smoke contains tar, SO_2, H_2 SO_4 and some hydrocarbons. These are responsible for various forms of respiratory diseases like, asthma, bronchitis and lung cancer in the susceptible persons.

Trees have a significant role in air purification. They consume Co_2 and discharge O_2. But our city is gradually being depleted of trees, when we have very few of them. In the western countries the ratio of green in towns and cities is about one third to two third for dwelling houses. In our city it is now less than one tenth. So if we want purification of air, we shall have to plant and nurse the trees, which again is very difficult task. Factories have to be set up in planned manner, away from living zone. Coal should be least used for domestic purpose.

With so many problems facing us, objective to achieve "Health for all by 2000 A.D." appear to be an impossible task. To me, most of our problems are due to population explosion. There is a ray of hope if growth of population could be checked. If we can provide accommodation for the homeless and canal sides may be cleared of the destitutes. If jobs can be provided for people, theft of municipal fixtures and fittings might be prevented, footpaths and markets may be cleared of hawkers, by which traffic movement will be fast. Adequate food may be supplied to the people, if growth of population can be checked.

But, this will not be achieved by requests or by advertisements in newspapers, cinemas and hoardings at roads junctions. A small section of educated people will practice family planning, but large part of population, specially the uneducated section will not lend ear to requests neither will look to the advertisements. All that is needed for them is penal measures if any family fails to observe family planning principles.

I am afraid that our Government is not willing to take such drastic steps. Moreover relegious restriction are often taken as a plea against family planning in our country. But Bangladesh being a Muslim State is practising population control. Religion do not stand in the way of family planning in that country. Republic of China, though a Socialist State have enforced by legislation to withdraw many facilities of a family if the couple get more than one child. Why similar measures cannot be taken in our over-populated State.

If we are serious about the slogan of Alma-ata we have got to enforce some drastic legislations. Today our birth rate is 33 per thousand and growth rate is 24 ; people are living longer years due to improved treatment. Population is swelling every day and that is the reason for many of our ills. Remedy for the ills are to bring down population, by which our dream of Health for All might be fulfilled if not in 2000 A.D., may be few years after, otherwise it will remain a mirage. □

KHATAL IN THE CONTEXT OF ENVIRONMENTAL HYGIENE

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KHATALS as we see in the city of Calcutta and its surrounding area may be described as temporary structures made of cheap types of materials to house the cattle. The growth of khatals were encouraged by the necessity of fluid milk for our daily life. The cattle were being brought from the up-countries; viz., U.P., Punjab, Haryana; etc. Khatals thus began to grow like mushrooms every where in the city and its suburbs. The number of khatals were about 2215 accommodating about 40,000 cattle as revealed by the survey conducted in 1972-73 by the Department of Animal Husbandry and Veterinary services.

Hygienic aspect of khatal

After some spot inspection, it was found that most of these khatals are run in extremely bad manner creating adverse effect on public health and environment. There is no proper arrangement for disposing cattle dung, waste fodder and other wastes. These are heaped around undesirably in open air for quite long time causing nuissance in various ways. The slurry from the cattle-shed washes including waste hay and fodder find way into the drainage and sewerage systems causing surcharge load on these utility services. Sometimes the systems get choaked causing serious problems. The cattle dung and other waste matters including waste fodder; hay and vegetable particles are heaped around here and there and not cleaned at proper time and in proper manner. These things get decomposed due to action of microorganisms. As a result, objectionable gases like methane; NH_3, H_2S in traces, etc.; are produced. The uncleanliness and improper drainage creates swamps and the whole spot becomes a breeding ground for mosquitoes. Objectionable smells and odours pervade the surroundings. As a result the environment of the surrounding area gets badly polluted. The cattle dung and urine contains very high BOD and suspended solids which when find entry into the treatment units; their efficiency may be seriously affected.

Inspite of these serious drawbacks of khatals, these have been existing in the city and its suburbs for long as these were the primary source of fluid milk which is essential for the babies and the old people. So there was an indirect indulgence towards the existence of these khatals from the people.

But day by day the nuissance problems created by khatals and threats posed by them towards environmental hygiene drew attention of the people. Some organised milk Colonies also came up at Haringhata and Dankuni with some regular supply of milk though very much scanty in respect to the existing demand. These made the politicians and high officials feel that such khatals causing health and environmental hazards should be immediately removed from the city and its suburbs. At the same time it was felt that some substitute arrangement for supply of milk, which was much in shortage than the demand, be made.

Animal Husbandry and veterinary Services Department came forward along with CMDA to launch cattle resettlement programme to rehouse the cattle of the existing khatals to some organised milk colonies so as to enable the cattle owners to carry on with their livelihood in a decent manner and to ensure the supply of milk from those colonies to the people of the city. Some sites, viz., Ganganagar, Garden Reach and Howrah have been selected for the purpose. Besides these, a programme for re-housing about 5,000 cattle has been proposed in the East Calcutta township taken up by CMDA.

Existing conditions in the city of Calcutta

Within Calcutta Corporation area there are about 2,215 khatals accommodating about 40,000 cattle according to the survey conducted by the Department of Animal Husbandry and Veterinary Services, Govt. of West Bengal in 1972-73. In 1976 about 10,000 cattle were removed from the city to Haringhata. But probably the same number have already entered in the city by this time. The percentages of cows and buffaloes are about 40% and 60% respectively within the city. The Table 1 shows the wardwise distribution of khatals within Calcutta. The city of Howrah accommodate about 20,000 cattle in about 500 khatals.

Present resettlement Programme

Since Khatals are becoming more and more incompatible use within the cities and urban areas, it is felt essential to remove the cattle from the potential urban areas and resettle them in suitable localities in the fringes of the city.

The following issues are involved in removal and re-settlement :

(a) The sites of relocation.
(b) The minimum facilities to be provided in relocation areas.
(c) Organisation and management of the newly settled cattle colonies.
(d) Phasing of the schemes.
(e) Utilisation of the land vacated by the khatals.
(f) Legal steps to enforce prevention of the future growth of khatals.
(g) Financial involvement in the whole process of removal and rehabilitation of khatals.

Removal and Re-settlement of Khatals of the City

Success of these removal and resettlement programmes depend very much on the efficiency of collection, preservation and marketing facilities of milk and other milk products. In practice, fresh milk from khatals goes direct to the consumers. But here storage, chilling and bottling will be necessary before supply. Therefore the location of the sites should be either in proximity of the existing organised dairies or chilling arrangement should be provided on the site itself.

Minimum facilities to be provided in the cattle resettlement areas

The facilities which are conducive to the good health, comfort and production of milk of the cattle should be provided in all such relocation areas. The standard codes of practices recommend certain norms in planning & designing the basic elements of these organised cattle colonies. Besides, the experience of the animal husbandry and veterinary services department may be utilized for the purpose. The standards have been adopted in the organised colonies under execution at differenct places in CMD area.

Disposal of cattle dung from the relocation areas

Cattle dung is produced at the rate of 10 kg per animal per day. Hence an enormous quantity of dung will be accumulated in the cattle colony. The effective and efficient disposal of such huge quantity of dung would create a serious problem. The modern idea is therefore to install Gobar Gas or Bio-Gas plant where the raw dung will be digested and gas would be generated at the rate of 1-1.2 Cft. per kg of raw dung. This gas may be used for cooking and lighting purposes. The slurry coming out from the plants may be used as manure after drying properly in drying beds.

Several project sites have been identified by CMDA for cattle resettlement programmes, viz., at Ganga Nagar, Gardenreach and East Calcutta. Among these projects the Ganga Nagar Scheme has recently been completed.

Case Study at Ganga Nagar

The cattle resettlement site at Ganganagar is located at about 25 km away from the city of Calcutta to the immediate north of Dum Dum air port. The total area of the site is about 19.62 acres. A natural drainage

TABLE 1·1 Distribution of Cattle population in Calcutta in 1972-73

Ward No. 1	No. of Cows 2	No. of Buffalows 3	Total No. of Cattle 4	No. of Khattals 5
1	354	982	1335	70
2	260	204	464	46
3	50	80	130	21
4	131	145	277	25
5	66	390	456	14
6	44	3556	3600	23
7	275	143	418	15
8	849	157	1006	41
9	484	111	585	21
10	929	175	1104	28
11	286	288	574	35
12	27	180	207	18
13	216	750	966	58
14	863	641	1504	44
15	121	34	155	10
16	1133	356	1489	56
17	86	—	86	9
18	189	—	189	19
19	219	148	367	39
20	160	117	277	14
21	—	—	—	—
22	96	87	183	19
23	108	107	215	14
24	83	29	112	14
25	65	56	121	14
26	100	101	201	14
27	85	18	103	11
28	81	24	105	11
29	96	55	152	9
30	152	258	410	19
31	392	386	678	14
32	670	470	1149	32
33	134	144	278	30
34	76	135	211	11
35	27	16	43	6
36	19	245	264	22
37	38	25	63	10
38	58	56	114	13
39	47	39	86	6
40	80	133	213	12
41	21	91	112	2
42	79	59	138	16
43	120	216	336	4
44	121	58	179	15
45	56	3	59	6
46	44	255	299	23
47	18	111	129	9
48	53	25	78	11
49	63	5	68	11
50	85	41	126	17
51	26	8	34	5
52	34	154	188	17
53	8	—	8	81
54	14	83	97	3
55	6	141	147	5
56	119	53	172	12
57	12	130	142	4
58	3	14	17	3
59	—	—	—	—
60	18	46	64	33
61	112	981	1073	35
62	76	698	774	29
63	86	552	638	10
64	19	—	19	4
65	17	7	24	5
66	28	173	201	5
67	46	273	319	27
68	189	778	967	34
69	49	893	982	26
70	63	626	689	20
71	369	295	1264	58
72	712	1145	1857	80
73	137	154	291	15
74	116	120	236	13
75	145	173	318	10
76	365	425	790	59
77	183	167	350	11
78	61	177	238	14
79	21	90	111	18
80	69	112	181	13
81	260	894	1154	64
82	117	150	327	39
83	177	747	924	41
84	360	785	1145	25
85	32	58	88	9
86	10	50	60	9
87	75	145	220	25
88	17	16	33	4
89	177	86	263	44
90	315	334	649	61
91	65	1	66	10
92	104	24	128	16
93	84	132	216	22
94	90	70	160	14
95	89	145	234	22
96	85	147	232	10
97	130	112	242	18
98	31	35	66	5
99	83	80	183	17
Total	15774	24001	39935	2215

channel, Noai Khal runs by the southern side of the project area. The project area is also connected by road and the railway station is also not very far off. Tables 2 & 3 show the land utilization on various components of the project and the probable cost estimates.

TABLE 2 : Land Utilisation at Ganganagar

Sl. No.	Uses	Net area in Sq. m.	Gross area in Sq. m.	Gross area in Acres	Percentage
1.	Cattle shed	13894	17368	4.29	21.86
2.	Paddock	8506	10633	2.63	13.40
3.	Bull's shed	100	200	0.05	0.25
4.	Wallowing Tanks	4440	5920	1.46	7.44
5.	Hay Stack Yard & Chatting shed	920	1050	0.26	1.32
6.	Central Feed Store	850	1000	0.25	1.27
7.	Veterinary Building with shed	725	1000	0.25	1.27
8.	Administrative Building	300	900	0.22	1.22
9.	Milk Reception Unit & Parking	63	625	0.15	0.75
10.	Housing for				
a)	Ah & VS Personnel	210	1375	0.33	1·72
b)	Cattle owner	490			
c)	Cattle Attendants	375	4600	1.13	5.66
d)	Care taker	22			
11.	Bio-gas plants	7400	8680	2.14	10.95
12.	Water Supply & Drainage	4200	4200	1.04	5.30
13.	H. T. Line & Electricals	720	720	0.20	1.02
14.	Community pond	2464	3285	0.81	4.12
15.	Open space	5140	5140	1.27	6.47
16.	Roads & Path ways	12700	12700	3.14	15.98
	Total	63514	79396	19.6200	100.00

TABLE 3 : Project Cost of Cattle Resettlement at Ganganagar

Sl. No.	Item of Work	Area/plinth area in Sq. m. Length in metre	Rate	Cost Rs.	Total amount Rs.
1.	Land Acquisition	19.62 acres	Rs. 50,00.00 per acre		9,81,000.00
2.	Survey work		L.S.		60,000 00
3.	Land filling & Dressing	19.62 acres	L.S.		1,71,000.00
4.	On site infrastructure :				
( )	Road & Pavement	12,700 Sq m.	Rs. 118.00 per sq. m.	15,00,000.00	
(b)	Drainage & Water supply		L.S.	19,47,500.00	
(c)	Bio-gas plants 4 Nos.		Each @ Rs. 2,50,000 00	10,00,000.00	
(d)	Electrical Installation etc. (including street lighting and structures)		L S.	20,00,000.00	
(e)	Land Scaping	19.62 acres	L.S.	40,000.00	
				64,87,000.00	64,87,500.00

(Contd.)

TABLE 3 (cont.)

5. *Cost of Structure* :				
(a) Boundary Wall	1450 M	Rs. 172.42 per M Length	2,50,000.00	
(b) Administrative Block	300 sq.m.	Rs. 600.00 per sq.m.	1,80,000.00	
(c) Feed Store	850 sq.m.	Rs. 530.00 per sq.m.	4,50,000.00	
(d) Veterinary Block facilities	820 sq m.	Rs. 320.00 per sq.m.	2,30,000.00	
(e) Bull shed	100 sq.m.	Rs. 180.00 per sq m.	18,000.00	
(f) Chaffing shed & Hay stack yard	920 sq.m.	Rs. 126.00 per sq.m.	1,16,000.00	
(g) Cattle Shed & Paddock	22400 sq.m.	187 57 ,, ,, ,,	40,00,000.00	
(h) Milk Reception Unit	63 sq.m.	603.00 ,, ,, ,,	38,000.00	
(i) Housing for AH & VS Deptt.	470 sq.m.	681 00 ,, ,, ,,	3,20,000.00	
(j) Housing for cattle owner & Cattle attendants	2800 sq.m.	643.00 ,, ,, ,,	18,00,000.00	
(k) Care Taker residence	22.00 sq.m.	550.00 ,, ,, ,,	12,100.00	
			74,14,100.00	74,14,100.00
6. Installation of Equipment & Machines etc.		L.S.		1,40,000.00
7. Miscellaneous		L.S.		2,00,000.00
Grand Total				Rs. 154,53,600.00

Utilisation of land vacated by the khatals

As soon as the khatals would be removed from their existing locations, the lands will fall vacant. Therefore, utilisation of these lands require proper schemes and ideas. There is a dearth of open space in the city. So most of these lands my be utilised for parks, play-grounds and totlots to create some greeneries. Some of these sites may also be utilised for primary schools, public libraries, community halls, Health centres, etc., as may be suitable for the purpose.

It is therefore, an essential task to make the city free from so called khatals to create a healthy environment congenial for living. Proper phasing of programmes for removal and resettlement of khatals is required so that by 2000 A.D., we can see our city free from such nuissance and at the same time people can get milk near at hand upto their requirements. The present programme that are in progress was evolved by the State Government at a Project cost of Rs. 7.36 crores with the assistance of Dutch Government. It has been estimated that a land area of about 8.55 acres and an amount of about .53 crores would be required to remove every thousand cattle including calves.

Another important aspect on which the success of these resettlement programmes depend is the legal aspect. Cattle Licensing Act has been introduced in this regard. Strictest enforcement and vigilance is required. ☐

WET LANDS AROUND CALCUTTA

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AS a small air plane cruises from Behala air strip and skirts Calcutta Metropolis one will come across the landscape dotted with innumerable wetlands or *bils*, mudflats, marshes, streaks of trickling dirty water, green holes and bogs of every description. A network of stagnant or moribund canals criss-cross the hinterland of Calcutta and the total area is harbouring different types of flora and fauna. At the southern precinet of the city you will find Shib-Hooghly bil and as you cruise due south east one after another appears Kulpukur, Rula Bil, the bogs of chocked up Vidhyadhari, Salt Lake, Bhangar Bil, Dhapa Bil, Baita Bil, Kalinga Bil, Dhanchandsi Bil and ultimately Mathura Bil near Kanchrapara, Without enlarging the list one can presume a similar number of bils and wetlands also exist on the other side of the river Bhagirathi.

"What utility have these wetlands" ? A citizen may ask and in all probability will raise his brow and shrug in exasperation to hear the answer. Almost all the down streams serve Calcutta as sewage canals and every day hundreds of thousand litres of sewage water runs off from the great metropolis. These bogs decompose the injurious contaminants and supply that vital elixir for growth of kitchen vegetables to the Calcuttans. A second boon is the pisciculture which practically survives on the manures thus received from the filthy water that washes down Calcutta round the clock. The relentless service started 300 years ago when Calcutta was just born. Besides the abovementioned wetlands and mud-flats there are innumerable municipal ponds, railway cuttings and unused wasteland that contain rain water at a certain period of the year. The municipal ponds serve the need for house hold and cattle shed water while most of the railway cuttings and wastelands that grow sundry woods also serve their ecological necessities. At the present moment some of the mud flats are utilised for capital crops but mostly are untouched and only harbour a myraid of microbes and insects while shallow waterlands grow water hyacinth in abundance. The wetlands in the vicinity of saline and brackish water regions are bereft of Blue Green Algae which in all probability can be introduced. One great purpose these bags and wetlands are serving by growing the greens, that produce oxygen and without any hesitation we may say while we have never tried to conserve the fauna around Calcutta and neglected these marshes, the wetlands in turn are gratefully hosting the local fauna.

As these are now full of filth and contamination that has no apparent intrinsic value these vast sheets of shallow waters can be converted into economically viable propositions should we care to give them a little face lift. We are sure a little rusing will do a lot of boonful contributions to our agriculture, pisciculture draught and flood control, tourist attraction and in all probability will give Calcutta a new lease of life in 2000 A.D.

Rain Cycle—Flood Control/Irrigation and water table

All parts of hydrosphere are linked together in a single cycle. It has been estimated that about 875 km^3 of water evaporate daily and only 100 km^3 of it returns to the mother earth by down pour and runs to the ocean as run off waters. The distribution of rain is not even in all the years and in a certain year we get excessive downpour in the upstreams that create havoc in the estuaries. It is typical of our country to think about flood control while we just do not think of storing water when we get the waves of excess water. There lies the necessity of determining the rain cycle and our planners must prepare reservoirs or storage tanks to hold the flood water. For centuries our wetlands around Calcutta have been passing the water to the Bay of Bengal. Due to cumulative silt deposition and neglect their carrying capacity has been steadily decreasing. These shallows in some part or the other remains dry during the year and it should not be a difficult job to even manually desilt them and make accommodation for holding more water. Containing water in shallows means larger surface area which results more evaporation under sunshine. This also results in drying up of subsoil water. The process of lifting subsoil water for municipal use has also deepened the problem by reducing the depth of water table. We have been drawing water by deep tube-wells almost indiscriminately which again results in subsiding water level. One should not exclaim to hear that in 1960s we had the water bearing stratum just 20 to 22 feet under our city. Now in 1984 the level has gone down to 36 to 38 feet. The condition was worse in 1982. In that year of draught the water level went further down to 40 to 42 feet. Had we had the idea to deepen our wetlands the excess water that we had in 1970 and 1978 (please remember the years of flood ; 1956 ; 1964 ; 1970 ; 1978) the entire picture could be drawn in a different colour.

The gloom that has haunted the landscape are mainly the pollution of the water slurry sediments and silt deposition. The problem requires special approach and treatment. However, it will not be out of place to discuss at least some aspects of the purification technology that may help develop the wetlands and water passages. With a view to develop these wetlands and marshes we must primarily clear them of filths and sediments that gradually chocke the canal beds and the bils. The process involves transformation of injurious contaminations from the fluid and subsequent separation and desilting of the beds. Hence to start with we must ascertain what are the contaminants that are present in such waters. To what extent we may endure the water that contains such contaminants and what method may be undertaken to transform or dispose off such contaminants and finally how these bogs could help conservation of ecological phenomena and obviously improve the condition of public health.

The contaminants

The contaminants that are carried by the water passages under consideration mainly consist of organic water of municipal use industrial effluents and minerals. While the minerals other than industrial effluents can only be separated by desilting the industrial mineral effluents must be controlled at the source. That is to say the Act of 1974 and 1981 should be enforced vigourously. The organic contaminants of municipal waste can best be managed by bacteriological methods. It will be pertinent to this discussion to produce a table (Table 1) of allowable contaminations in water for ready reference of our participants in the seminar. The original list contains a wide range but an extract will suffice for our area of discussion.

TABLE 1 : Maximum Permissible Concentration of some harmful substance in waterbodies in general use

Pollutions	Maximum Permissible Concentrations (mg/ltr.)
Aniline	0.1
Benzol	0.5
Bromine	0.2
Arsenic	0.05
Nickel	0.1
Polypinine chloride	0.2
Mercury	0.005
Lead	0.1
Formal dehyde	0.05
Cynides	0.1
Ammonia Content of Nitrogen	2.0
Norsulfazole	1.0
Benzine	0.1
Hexachloride	0.02
Malathion Insecticide	0.05
Kerosene	0.1
Copper	1.0
Oil	0.1
Carbon Desulphide	1.0
Tarpentine	0.2
Metaphosphate	0.02
Phenol	0.001
Chlorophos	0.05
Detergents	0.5

Without entering into the details of the pollution caused by tanneries, dyes and chemical, battery manufacturing and paper and other industrial affluents we should stress that the method of ion exchange should be resorted to check the pollution of metallic contaminations at the source. Rayon industries should take the help of experts of becteriology and polymer scientists to disintegrate their contaminants that flow from their plants.

It is understood, as a part of 'Wet Survey' the West Bengal Prevention and Control of Water Pollution Board in connection with effluent sample survey of Ganga River Basin Collected samples of water from Tolly's Nullah, Ichhapur Canal, Circular Canal and Bagjola Khal. They must have submitted their analysis of such samples in respect of physio-chemical and bacteriological parameters. I hope serious efforts will be made to check the pollution in water passages that have now become sewer canals to reach the bodsdown the south of the metropolis. Hundred of tons of silts are deposited for years together and the river beds have become mud-flats. Every day millions of gallons of pollutted water run through habitations and the atmosphere is vitiated. Chronic amebiasis is present in almost everybody whosever has consumed water of Calcutta. One, however, should not think that whenever there are contaminants it is fatal and coloured water also is not necessarily harmful for every purpose.

A great portion of organic, inorganic, acidic and alkaline contaminants are being converted by natural process. In the natural process organic bodies decompose and give birth to a new food and abode for micro-organisms. Nitrogen is also produced. Similarly oxidation is also taking place in the natural course of these water. But these are mainly organic bodies. It is however an advantage that the contaminants in the wetlands are mostly organic. Hence if ion exchange methods are resorted to at the source our task will be mainly to convert organic substances and subsequently silt clearing to give a new life to these wetlands.

Unfortunately the natural process is very slow and the accumulation of waste is so huge that the carrying capacity is fast dwindling. There lies the requirement of artificial methods of purification. In our wetlands where the water is mostly used for agriculture and pisciculture among others the biological purification method appears to be most suitable and economically viable. There are two accepted biological methods, aerobic and anaerobic ones. Where there is a constant flow of waste water like our Bagjola Khal or Central Canal, aerobic method is best applicable and we can use active silt for purification of water. Active silts consist of fine brown flakes containing an enormous amount of various bacteria from 10^8 to 10^{12} cells per gram of dry silt. Bacteria of the Pseudomonas genus oxidises phenols, aliphatic acids and spirit. The microbacterium genus oxidises different hydrocarbons; the bacterium genus; (upto 30 species) oxidises oil, paraffins, aldehydes and others. The biocenosis of active silts also include the simplest of organisms (Radiolaria, Flangellates, Infusoria) Ratifera, fungi, Algae, worms, tick, fly, larvae all of them contribute to the process of putification either directly or indirectly. Active silts mixed with running water keeps the former in suspension for the nutriment and oxygen is supplied so that a favourable condition is achieved for the microbe cells, care should, however, be taken with regard to oxygen supply and flake size ratio. It has been found that biological consumption of waste that has gone through the acrotanks is reduced from 300-400 mg/ltr. – to 10-15 mg/ltr. i.e , the oxidation of organic substances is almost total. The method will not be very difficult to apply in case of the waste water of our city that flows through the Bagjola Khal or Central Canal. These canals are already embanked with brick work along considerable stretches and a little finishing touch will convert them to acrotanks. The decomposition of silt wastes can be done by anaerobic methods and finally desilting can be resorted to even manually. For most of the wetlands remain dry in some part of the year or others. We have a vast human resource of rural labourer who can be utilised for cleaning up the silts of such waterpassages. The mannures thus obtained will preduce multiferous advantages including reclamation of the so called wastelands. That will create a real green belt and host the local flora and fauna.

Flora and Fauna

In spite of the looming large gloom over the wetlands it is gladdening to note that these are hosting the representative fauna and flora of Lower Bengal. The area is having a combination of Tropical and Monsoon Rain forest and remains green throughout the year. One should not think of filling in the lowlands. On the other hand we should think of restoring the grasslands which were in existence in the near part and then the landscape will be complete to represent the true character. The intervening stretches between two lowlands can be joined together by afforestation and a continual evergreen belt can be created for sheltering the local fauna and they will be saved from extinction.

In this connection I take liberty to mention that there are several species of animal world that used to live in such areas and have been pushed further down to the Sunderbans and in the face of harder competition for survival they are almost extinct. One may be reminded that Hog Deer which was locally called as Chhagla Harin is now extinct from here. There is no trace of a Kukure Harin i.e. Barking Deer, neither is a leopard available. The fishing cats are hard to find. Water monitors are scarce. Innumerable rough and course fishes are lost forever. These animals do not need dense forest but a little care will do enough of good to rehabitate them. These animals were used to live in the vicinity of human population of these areas and one may be sure of enriching these wetlands with their rehabilitation for the anjoyment of the future generation.

Urban planning must have a positive approach towards rational and optimum of our waste and wetlands. We must strike a balance between ethics of growth and ethics of conservation. There are two extreme views. One does not care for conservation of the ecosystems while the other group always gives a strident call of the Doomsday.

The judicious utilisation of our renewable natural resources should be of paramount interest. We must have a pragmatic approach to our problems and the fruit of our efforts must be made available to our citizens. For instance if pollution by wastewater and the subsequent arrest is properly made known to our citizens they will actively participate in our programmes. Our farmers were sufficiently modern in adopting new fertilisers which have eventually yielded appreciable results. Similarly they are expected to help keeping the wetlands in fair health and will also keep a vigil against further deterioration. So long we will not be able to involve them they will remain indolent and despise any dream of a rosy "Calcutta 2000 A. D."

Appreciating all these needs for today and to-morrow the Prime Minister of India Mrs. Indira Gandhi during her inaugural visit to Calcutta Past, Present and Future exhibition paused for a longer duration infront of the environment and green belt panel and said—"**Take care of the nature around the metropolis.**" □

TRAFFIC NOISE LEVEL IN CALCUTTA

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NOISE pollution has been considered to be one of the major environmental problems in recent years when more and more people have become exposed to the dangers of excessive noise in everyday life. Exposure to such noise causes irritation, discomfort, headache, nervous and cardiovascular disturbances and in extreme cases may lead to the parmanent loss of hearing.

Calcutta is one of the most densely populated cities of the Indian subcontinent and it suffers inevitably from various environmental problems. Noise pollution is one of the major contributories to these problems. The overall intensity of environmental noise is increasing keeping pace with the growing industrialisation and urbanisation. Traffic noise is one of the major pollutants of environment, particularly in built-up areas. So far no organised effort has been made to survey the noise level in metropolitan Calcutta.

TABLE 1 : Traffic noise levels of different traffic junctions of Calcutta

Sl. No.	Traffic Point	Noise level in dB (A)								
		9-00 — 11-00 A.M.			12-00 — 2-00 P.M.			4-00 — 6-00 P.M.		
		Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
1	Sealdah crossing	88	75	80	85	75	82	95	80	85
2	Manicktala crossing	85	80	83	87	80	85	95	80	85
3	Ultadanga-VIP crossing	80	75	78	87	72	75	95	75	78
4	Shyambazar 5 point crossing	85	80	83	85	75	80	90	80	85
5	College St. crossing	87	80	82	85	75	80	88	75	82
6	B. B. D. Bag	90	80	85	85	80	82	93	82	87
7	Bowbazar crossing	88	80	84	85	80	82	90	85	87
8	Esplanade	85	80	82	85	75	82	87	80	85
9	Park St. Chowringhee	85	78	82	90	75	82	95	85	86
10	Rabindra Sadan	92	82	82	85	80	80	95	85	88
11	Hazra Rd. crossing	87	78	80	84	75	80	85	80	82
12	Rashbehari crossing	88	75	85	85	75	80	90	80	86
13	Garlahat crossing	90	80	85	80	75	78	95	85	88
14	Ballygunge P. S.	88	78	80	80	75	78	90	80	83
15	Park Circus	84	75	81	80	75	78	92	82	85
16	Maulali crossing	90	82	85	88	82	86	98	80	90
17	Howrah Bus Terminus	90	80	82	87	78	80	84	75	83
18	M. G. Road-Rabindra Sarani crossing	90	85	85	88	75	77	85	75	83
19	Posta Market Area	90	83	85	86	73	76	83	75	82
20	Ganesh Talkies	93	85	88	88	75	82	98	80	90
21	Sovabazar crossing	82	72	75	85	73	80	83	72	76
22	Grey St.-C. R. Ave. crossing	85	75	80	88	76	77	85	75	80
23	Thakurpukur	70	65	66	—	—	—	80	65	70
24	Amtala	75	65	65	—	—	—	85	75 *	78
25	Diamond Harbour	75	55	55	—	—	—	—	—	—
26	Falta	52	45	45	—	—	—	52	49	50

The present work describes results of a recent study undertaken to evaluate the extent of noise pollution in this city and to assess its effect on the population exposed to this hazard. It is urgently felt that methods of minimizing and/or eliminating noise pollution will have to be developed.

Methodology of Investigation

A comprehensive traffic noise level survey of the city was carried out by using a portable accurately calibrated sound level meter, Gen Rad type 1565-B at different traffic junctions. During recording of noise level data at each traffic point the meter was held at a distance of about 3 metres from the vehicular flow and at one metre above the ground level. The traffic points were selected considering the maximum concentration of vehicular flow at different sites of the city road network.

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Noise levels were recorded at three different time intervals during a day (9-11 A. M.; 12-2 P. M. and 4-6 P. M.) considering the maximum and comparatively less busy hours of the day. Three separate data were taken at an interval of 15 minutes at each point during the schedule periods and the maximum, minimum and average level in deciBels were considered for comparison.

Noise levels of some rural areas adjoining the city were also recorded for a comparative study.

Results and Discussion

The detailed survey report of the traffic noise level in dB(A) of metropolitan Calcutta is presented in Table 1. The major data show that the average traffic noise level of Calcutta is above 75 dB(A) which is beyond the acceptable limit. The maximum average sound level of 90 dB(A) was recorded during the evening period 4-6 P.M. at Moulali crossings and Ganesh Talkies crossings due to the maximum concentration and interruption of vehicular flow. The average noise level at Sealdah, Manicktala Crossing, Shyambazar 5-point crossing, Esplanade, Park Street-

1. Sealdah
2. Maniktola Crossing
3. Ultadanga-V. I. P. Crossing
4. Shyambazar 5-Point Crossing
5. College St. Crossing
6. B. B. D. Bag
7. Bowbazar Crossing
8. Esplanade (In Front of Cott. Indus.)
9. Park St.-Chowringhee
10. Rabindra Sadan
11. Hazra Road Crossing
12. Rashbehari Crossing
13. Gariahat Crossing
14. Ballygunj P. Station
15. Park Circus
16. Moulali Crossing
17. Howrah Bus Terminus
18. M. G. Road-Rabindra Sarani Crossing
19. Posta Market Area
20. Ganesh Talkie
21. Sobhabazar Crossing
22. Grey St.-Central Aven. Crossing

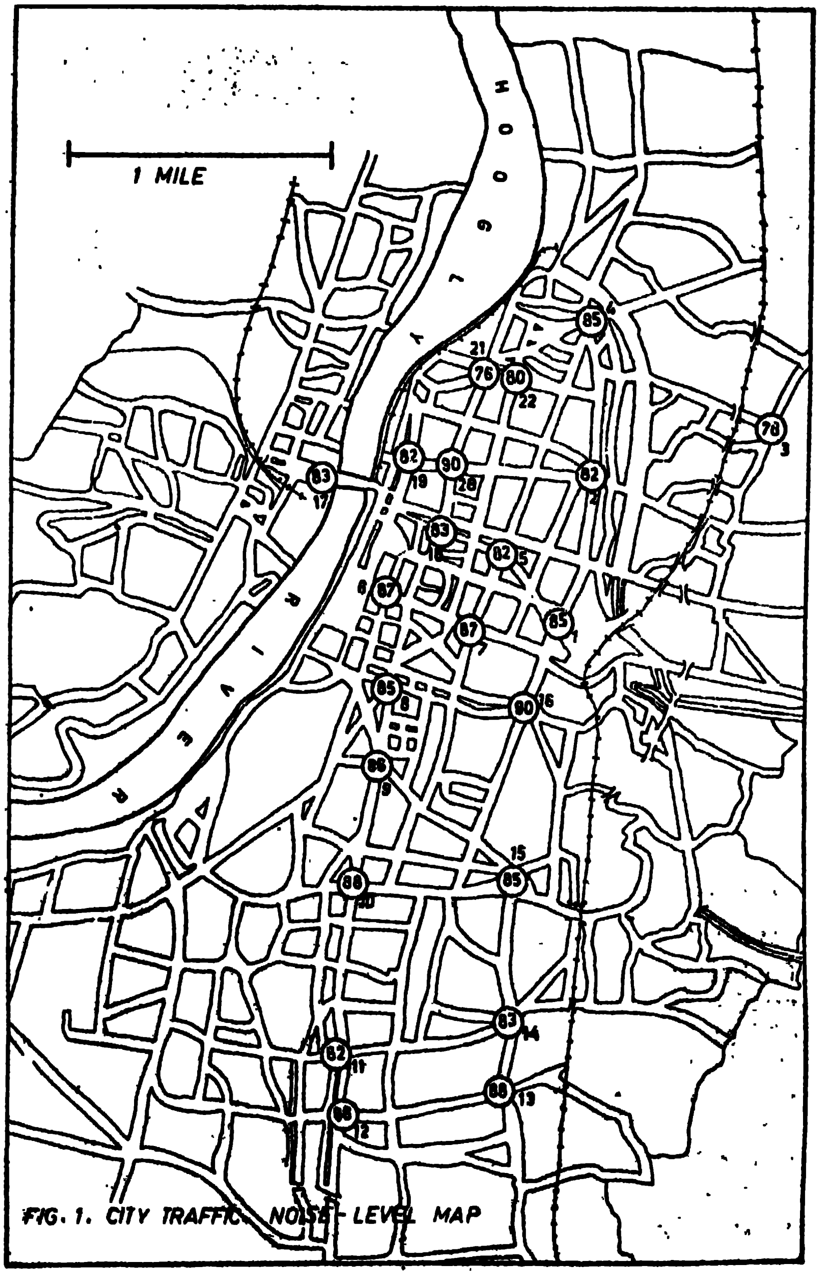

FIG. 1. CITY TRAFFIC NOISE-LEVEL MAP

Chowringhee crossing, Rashbehari crossing, Gariahat crossing, Howrah bus terminus, Posta Market and M. G. Road-Rabindra Sarani crossing exceeded 80 dB(A) round the entire period of investigation.

The variation of the noise level of five major traffic points of the city round the period of investigation is presented in Fig. 1. It shows that the traffic noise reaches its maximum level during 16-00 to 18-00 hrs. in all the five major traffic junctions. It is interesting to note from this figure that contrary to our expectations the noise level during the evening period at the Gariahat crossing is higher than that of Sealdah, Howrah or B B. D. Bag area. This is perhaps due to the extreme congestion of the vehicular flow at the Gariahat crossing which is the main point to connect the south suburban areas, e.g. Jadavpur, Garia, etc., with the north.

A map showing the locations where traffic noise levels of the city have been recorded is presented (Fig. 2). The noise levels recorded at four rural locations adjoining the city reveal that the average noise level there is far below the city traffic points. From these results it appears that the noise levels at different traffic points of the city exceed the standard permissible limits of noise exposures shown in Table 2, as prescribed by the Occupational Safety and Health Act (OSHA) regulations (1971).

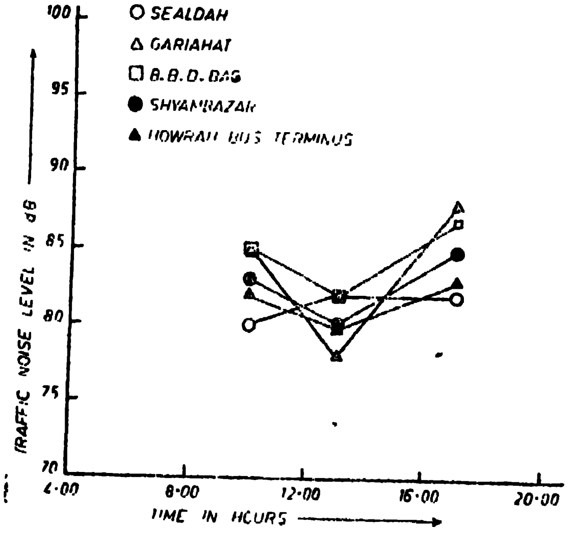

FIG 2 VARIATION OF TRAFFIC NOISE LEVEL AT CERTAIN MAJOR TRAFFIC JUNCTIONS OF CALCUTTA

The principal reasons for the high noise levels at different traffic junctions of the city appear to be : (a) congestion of the narrow streets, (b) continuous use of automobile horns by violating traffic rules and (c) interruption of vehicular flow by the pedestrians causing honking. During the present investigations it was common experience that at some traffic junctions like Moulali crossing and College Street crossing, the noise levels often increase to as high as 95-100 dB(A) due to indiscriminate use of traffic horns.

TABLE 2 : Permissible Noise Exposures*

Duration per day, hours	Sound level, dB (A) slow response
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

* OSHA (Occupational Safety and Health Act) regulations (Federal Register, May 29, 1971). 1910.95 Occupational noise exposure

In Calcutta we have already reached the danger limit of noise level exposure. Unless adequate measures are immediately taken towards prevention of this aspect of environmental pollution, the situation will further worsen for healthy growth of the citizens of Calcutta, which has already crossed the danger level. Similar investigations have also been carried out in other cities like Bombay (by Socleen group[1]), Baroda (Delhi IIT group[2-3]) etc. These results also show the graveness of the situation.

As a remedial measure, the following may be suggested : (1) strict enforcement of traffic rules, (2) statutory ban of the use of electric horns, (3) widening of the road surfaces, and (4) strict control of pedestrians to keep clear the road surface for vehicular traffic only. Some states and some cities and towns in the USA and many other countries have ordinances or laws that set permissible limits on noise from motor vehicles. Such ordinances have to be introduced in this country also. □

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LETTERS TO THE EDITOR

Landsat image analysis of forest depletion in eastern India

Degradation and deterioration of vegetation cover in the country is due to : (i) Population pressure of both human and livestock on vegetation cover, (ii) Rehabilitation and development works depleting forest cover, (iii) Encroachments on vegetation covered areas, and (iv) Faulty methods of land use.

Eastern India has its own problems which are affecting the ecological status of vegetation cover of the area. Faulty methods of land use especially in hilly and tribal inhabited areas have affected the productivity of the land. Large chunks of areas especially in different states of eastern India have been affected by shifting cultivation. This practice has resulted in successive degradation of vegetation cover. In hilly slopes which are 100% under cultivation result in accelerated erosion of top soil.

An attempt has been made in this paper to quantify the extent of shifting cultivation and change in area under vegetation cover at an interval of five years. The visual interpretation of Landsat imageries of band 5 and 7 black and white and false colour composites on band 4, 5 and 7 of the areas for the year 1975-76 and imageries on band 5 (Black and White) of year 1980-82 was done using × 10 lens on a light table.

The following interpretation key was developed and adopted for getting information from Landsat imageries.

(*a*) *Closed Vegetation Cover*

Well-stocked vegetation cover with a crown closer to above 40%.

(*b*) *Open Vegetation Cover*

Vegetation cover which has been badly affected by biotic interferance or natural calamities. The crown cover of such stand has been depleted to 10% to 40%. In degraded areas wherever local factors were favourble, plantations have been raised on such areas. The reflectence of such patches are similar to adjoining natural vegetation cover. These areas not only included tree forest but also included thickets and orchards.

(*c*) *Closed vegetation cover affected by shifting cultivation/biotic factors*

These included areas affected by shifting cultivation where the fallow period was long and adjoining forest gave the look of closed vegetation cover. This would also, include areas which have been newly taken up for shifting cultivation. Part of the areas under this category might be having a good vegetation cover.

(*d*) *Very open and scattered vegetation cover affected by biotic factor*

Shifting cultivation and other biotic factors with short fallow period resulting in deterioration of vegetation cover. Such cover has been reduced to a stage where scattered trees band thickets succeeded them.

(*e*) *Non-vegetation*

This included habitation, agricultural land, cultivable and uncultivable wasteland with scattered trees and shrubs.

(*f*) *Clouds/Gap*

Areas which are covered by clouds in the imagery, details of land use type could not be separated.

The areas under different land use types are given in Table 1 and 2.

From the tables we can infer as follows :

(*1*) *Orissa* : Large chunks of areas of the order of about 2 8% of forested area were affected by shifting cultivation which has increased between 1975-76 and 1980-82. In the similar way the area under closed forests has decreased to about 10%. While Simlipal still retains good forests ; there is widespread recession in Sambalpur, Parlakimidi, Delgarh, Banra hills and Bonailalli. Most of the forests in Koraput district have been affected by shifting cultivation.

TABLE 1 : Area under different landuse types (000 ha) using landsat images of 1981-82

State	Closed cover of vegetation	Closed cover of vegetation depleted by biotic factors	Open vegetation cover	Cloud/ Gap	Non-Vegetation	Total
Orissa	1300	2154	1885	—	10240	15579
Arunachal Pradesh	2901	2833	1500	299	825	8358
Assam	1180	875	876	25	4896	7852
Manipur	145	1300	500	182	109	2236
Meghalaya	240	585	439	155	829	2248
Mezoram	240	1500	211	—	158	2109
Nagaland	280	390	700	82	200	1652
Tripura	140	584	150	—	174	1048
Total	6426	10221	6261	743	17431	41082

TABLE 2 : Area under different landuse type (000 ha) using landsat images of 1975-76

Orissa	1416	2038	2085	—	10040	15579
Arunachal Pradesh	3500	2533	1614	—	711	8358
Assam	1200	991	765	—	4896	7852
Manipur	150	1406	448	—	232	2236
Meghalaya	250	708	661	—	629	2248
Mezoram	250	1521	260	—	78	2109
Nagaland	300	393	881	—	78	1652
Tripura	150	574	211	—	113	1048
Total	7216	10164	6925	—	16777	41082

(2) *Arunachal Pradesh* : This state yet retains large tarcts of forests and there has been less evidence of shifting cultivation. The area under closed vegetation cover has reduced drastically. This may be due to large scale industrial felling in the area.

(3) *Assam :* Karbi-Anglong and North Cachar hill districts show extensive shifting cultivation. Some portions of Mikir hill and Dansiri reserves have dense forests. Forests adjoining Bhutan and Arunachal Pradesh are under dense vegetation cover, Nambar reserve which was considered the home of wildlife has been depleted to a large extent.

(4) *Manipur and Mizoram* : These states have extensive areas under shifting cultivation. Quantitative figures of shifting cultivation of these two states have been given in Tables 1 and 2.

(5) *Nagaland* : The broad pictures of the forests show that the closed forests are in north western and western parts of the state. On ground inspection it has been seen that vast areas of these forests are secondary bomboo forests. Barring the Intanki reserve, other forests are not in a good shape.

(6) *Tripura* : The interpretation shows that entire eastern half is affected by shifting cultivation, western half has comparatively good vegetation cover. The vegetation cover of the area is either in patches or is running north-south in strips. The central catchment, Chandaipara, Manu, Chaitenga reserved forests are in consolidated big chunks but are affected by shifting cultivation.

(7) *Meghalaya* : About 60% of the forests is affected by shifting cultivation.

The figures in the tables show that total area under closed forests in all the states has decreased from about 7216 sq. km. in 1975-76 to 6426 sq. km. approximately. Similarly area under open vegetation cover has also reduced significantly in 1980-82. In order to save the area from total degradation some preventive measures in the form of settled cultivation or some other better method of land use is necessary.

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Effect of micronutrients on yield and sugar metabolism of some of the vegetables under Kumaun hill conditions

The use of micronutrients in agriculture as a tool for promoting higher crop yield and better quality has attracted the attention of scientists for the last few decades. Application of micronutrients has given encouraging results in fruit, vegetable and cereal crops by improving the yield and quality. There are some evidences that they influence the biochemical composition of plants by affecting the metabolism[1,2].

In hilly conditions, the availability of micronutrients is quite poor and that limits the growth, yield and quality of vegetables[3]. Under such conditions, investigations on the use of micronutrients for better production and quality vegetables, deserve attention. Keeping this aim in view, the present investigation on the response of boron, copper, iron, manganese, molybdenum and zinc on the sugar metabolism and yield of tomato (*Lycopersicon esculentum* Mill) and capsicum (*Capsicum annuum* L.) was undertaken at the Defence Agricultural Unit, Almora.

Tomato and capsicum were grown in micronutrient deficient soil[3]. Randomised-block design employing three replications and seven treatments including control was used for both the crops under normal cultural practices[4]. Two sprays of neutralised salt solutions of above micronutrients were given in the standing crops. First spray was made after 30 days of transplanting and second spray was repeated after 15 days of first spray.

After 70 days (for tomato) and 75 (for capsicum) of transplanting, the fresh fruits were harvested and analysed for sugar constituents Estimation of total sugars was made by phenol sulphuric acid method and reducing sugars by Lane-Eynon titrimetric method[4].

Micronutrients were found effective in increased yield and sugar contents on both the crops. All the micronutrients increased total sugar contents significantly over the control except Mo which reduced it significantly. Zn for chillies and B for tomato were found most effective where a respective increase of 31.26% and 30.39% was observed. Mn was found least effective with an increase of 6.99 and 8.13% over control for both the crops. Reducing sugars were increased by all the micronutrients including Mo. But Mo was found least effective for both the crops. Fe for tomato and Zn for capsicum were found most effective, increasing reducing sugars by 60.84% and 61.62% respectively over the control.

Non-reducing sugars decreased under all the micronutrients. But effect of Zn was found contrary, which increased it by 32.12% in tomato and reduced non-significantly in capsicum by 1.64%. Molybdenum reduced non-reducing sugars by 45.98 and 51.64% and was found most effective. It was observed that fresh fruit yield was also inhanced by all the micronutrients over control. Capsicum was found more responsive than tomato. In tomato, the effect of Fe and Mo was found non-significant. Highest increase in fresh fruit yield was observed under zinc. Lowest yield was recorded under Mo in tomato and Cu in capsicum.

These findings were found more or less similar to the findings of earlier workers for different crops[5,6]. The cause of higher yield under various micronutrients may be attributed to higher rate of photosynthesis and sugar formation due to enhanced chlorophyll contents and enzyme activity which ultimately lead to higher production of dry matter and consequently more yield. The increase of sugars as well as yield by Zn may be due to its involvement in all the six

TABLE I : Yield and sugar concentration under different micronutrients

Treatement	Total sugar				Reducing sugar				Non-reducing sugar				Fruit yield			
	Tomato %	% variation	Capsicum %	% variation	Tomato %	% variation	Capsicum %	% variation	Tomato %	% variation	Capsicum %	% variation	Tomato %	% variation	Capsicum %	% variation
Boric acid 0.25%	4.85	30.39	3.91	22.19	3.62	54.14	2.80	41.42	1.23	−10.22	1.10	−9.83	248.12	11.00	265.77	45.11
Copper Sulphate 0.4%	4.43	19.09	3.92	22.50	3.35	42.55	2.64	33.34	1.08	−21.17	1.20	−1.64	246.27	10.12	268.66	21.75
Ferrous Sulphate 0.50%	4.81	29.32	3.81	19.06	3.78	60.84	2.62	32.32	1.02	−25.55	1.19	−2.46	235.92	5.54	357.32	51.19
Manganese Sulphate 0.5%	3.98	6.99	3.46	8.12	2.66	13.19	2.52	27.27	1.32	−3.65	0.94	−22.95	317.75	41.64	256.83	34.30
Molybdic oxide 0.25%	3.24	−12.91	2.80	−12.50	2.50	6.38	2.21	11.62	0.74	−45.98	0.54	−51.64	230.72	3.34	308.88	39.96
Zinc Sulphate 0.5%	4.68	28.82	4.20	31.25	3.05	29.70	3.20	61.62	1.81	32.12	1.20	−1.64	347.97	50.49	368.69	67.03
Control	3.72	—	3.20	—	2.35	—	1.98	—	1.37	—	1.22	—	223.12	—	220.65	—
C.D. at 5%	0.150		0.069		0.149		0.196		0.214		0.296		22.07		32.42	

classes of enzymatic activity of plant metabolism[1]. Boron may be responsible for sugar-borate complex formation and hydrolysis of starch[9]. Increased quantities under Cu, Fe and Mn may be attributed to higher rate of chlorophyll synthesis, cytochrome photo-oxidase activity and enhanced rate of photolysis of water, which all contribute to more photosynthetic activity and higher production of sugars. The low-sugar contents under Mo may be attributed to the utilisation of sugars for the production of proteins due to increased activity of 'nitrate reductase' and 'ferrodoxin'[9,10]. The cause of general reduction of non-reducing sugars might be due to direct utilisation of reducing sugar for the synthesis of other metabolites.

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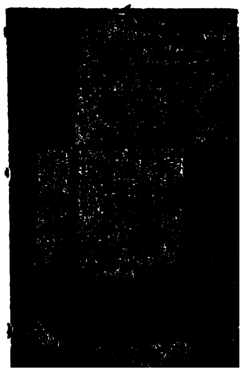

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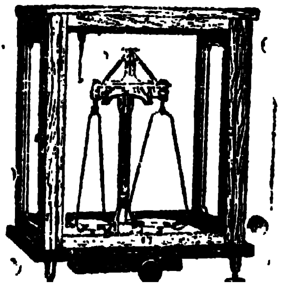

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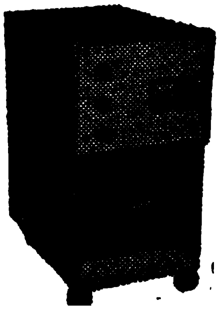

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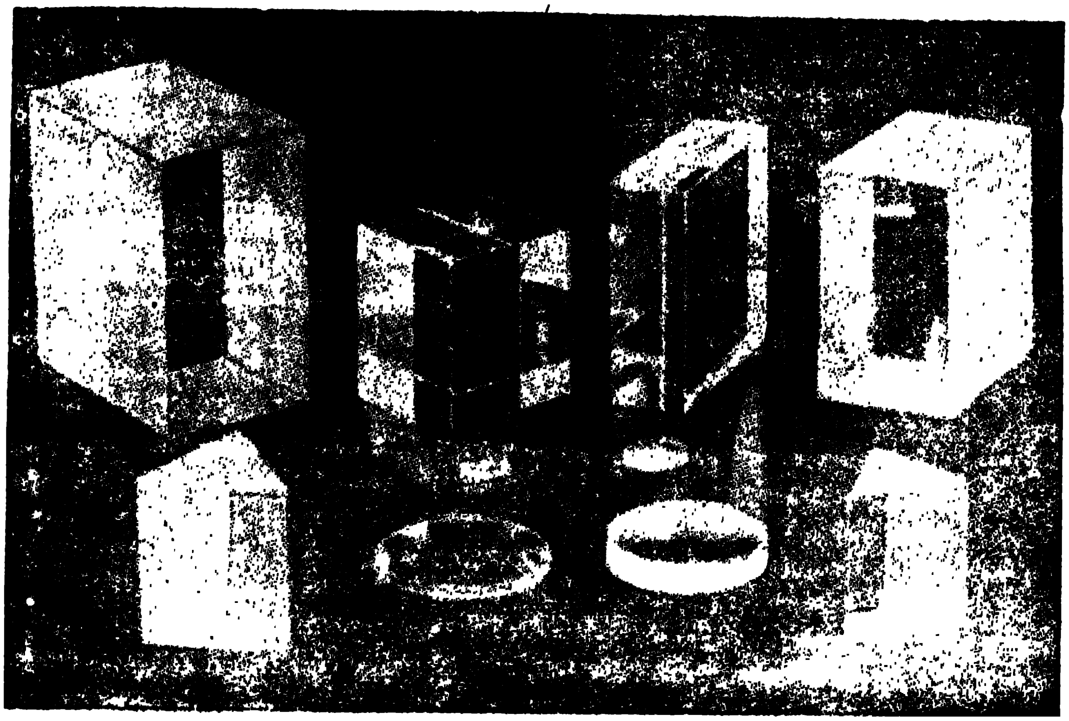

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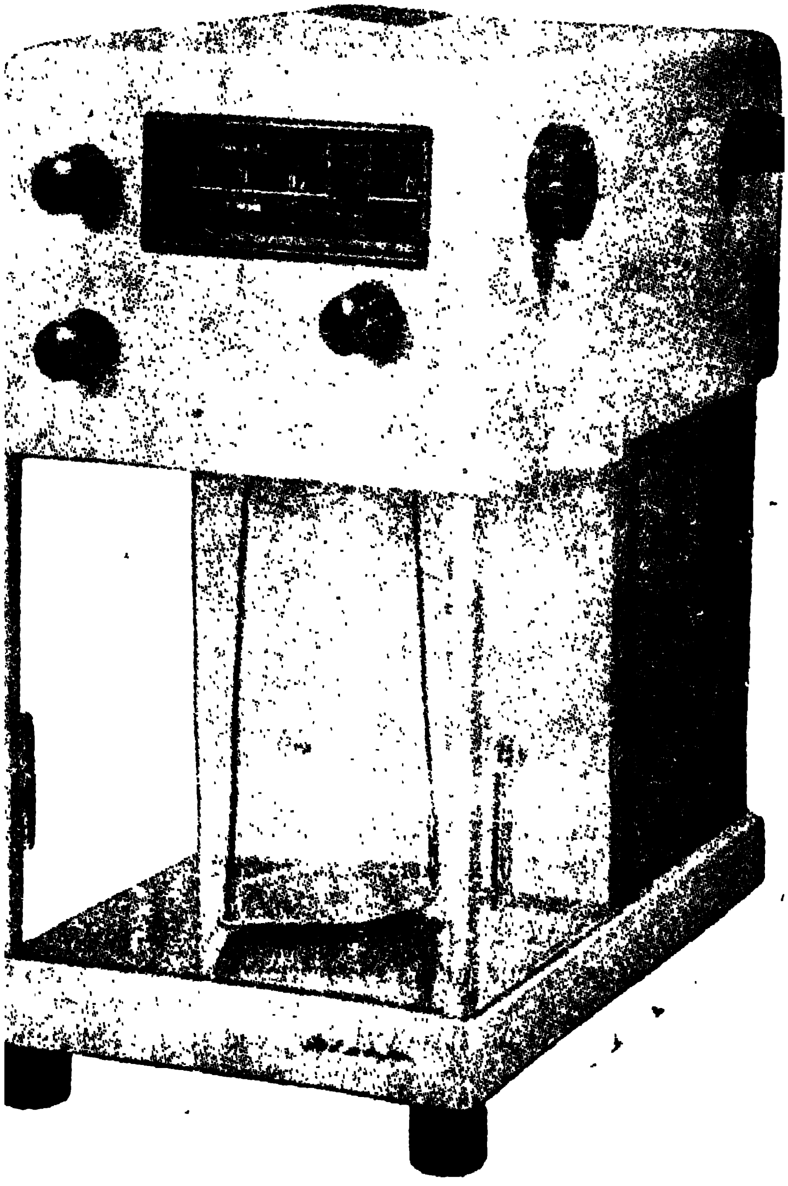

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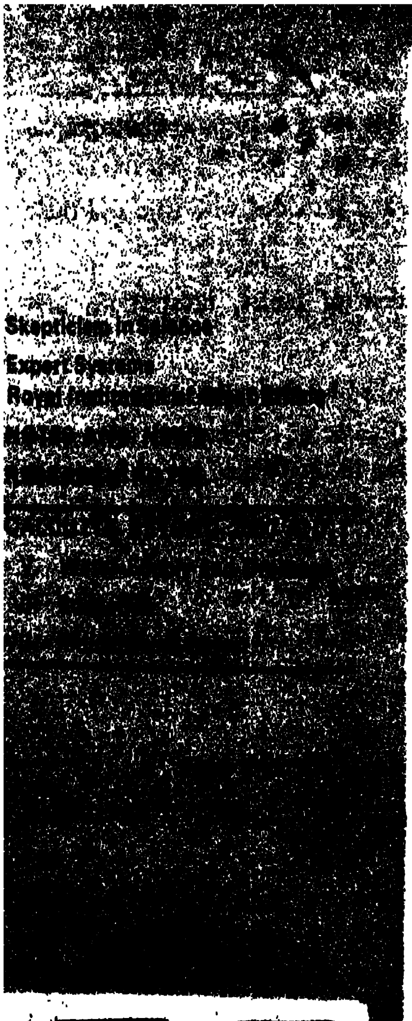

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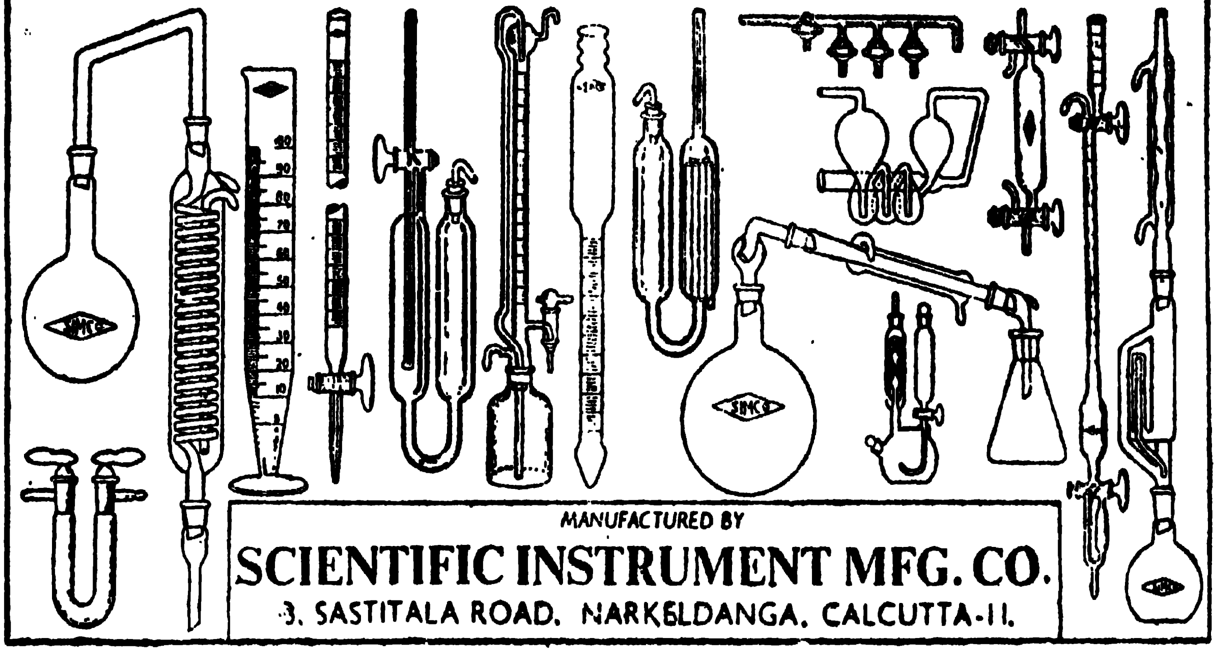

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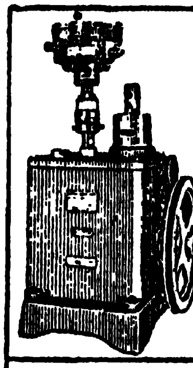

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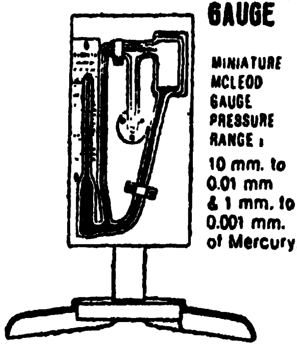

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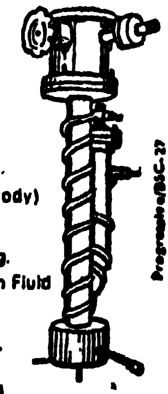

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SKEPTICISM IN SCIENCE

V. V. RAMAN*

FROM a philosophical point of view, a skeptic is one who doubts everything except the contention that it is impossible to achieve correct knowledge. Socrates' famous declaration, "All that I know is that I know nothing," is one of the earliest expressions of the skeptical point of view. All through history and in all cultures skeptical thinkers have questioned the beliefs and contentions of their contemporaries and of so-called authorities. Pyrrho and Aenesidemus in ancient Greece, Cicero and Empiricus in Rome, Carvaka in ancient India, Wang Chhung in China, al-Ghazali of the Arab world and Cornelius Agrippa of Renaissance Europe were all skeptics of one kind or another. Some of them, like Carvaka and Wang Chhung, attacked the religious beliefs of their period, while others, like al-Ghazali and Agrippa, ridiculed the cock-sureness of the scientists of their times. Skeptics of the modern period have generally been very suspicious of all that goes by the name of incontrovertible knowledge ; and this includes a great deal of science.

From this point of view, then, the scientist is certainly not a skeptic. For, the scientist's skepticism consists, not in the denial of human potentialities in the acquisition of knowledge, but in that he controlled by an ever-present doubt in the march towards knowledge. The scientist believes that it is possible to explain and understand the universe by the exercise of human faculties ; the philosophical skeptic holds that suuch hopes are vain. What is common to them both is that they hesitate to accept as true whatever may appear to be so at first sight.

The term skepticism derives from a Greek word which meant : to consider, to examine. In this etymological sense, the scientist is the true skeptic since what he does is to carefully examine every datum of experience and every statement about the physical world. This habit of thorough examination is ingrained in the scientific value system. Just as in the older schools of dogmatic philosophy there was considerable resistance to attempts at challenging well established notions and long accepted 'truths', in the scientific enterprise also there is resistance to attempts at introducing totally new ideas.

We may be tempted to conclude that the net effect of the two attitudes would be the same. But this is not so, because of an important difference. Challenge to a well sanctioned holy truth is blasphemy in the world of dogmatism. In the intellectual world of science, such challenges are not only wholeheartedly tolerated, but even encouraged. What else is scientific research but efforts to alter old views and usher in newer insights ? However, the contributions and conclusions of the would-be idol-breaker are subjected to pitiless dissection by the whole body of experts in the field before they are even given a provisional hearing. This inevitable fate of his findings encourages, indeed compels, the ardent scientific searcher to think twice, indeed twenty times, before he presents his findings to the scientific community at large.

---

* Dept. of Physics, Rochester Institute of Technology, Rochester, N. Y. 14623.

The cold-blooded skepticism of the scientific community vis-a-vis the findings of any single one of its members has two major consequences : one positive, and the other, not quite so. First, because of the checking and re-checking that go into play before conclusions are reached, because of the detailed scrutiny to which a new idea is subjected, because, in short, of the extreme caution which the scientist is obliged to exercise in his professional activity, facts and comments that the world of science enunciates are relatively more reliable than those emanating from other sources. This is not to say that scientists cannot err, or that they may not be ignorant of facets of the world yet unexplored. But what does seem reasonable is that in matters where disinterested people have probed, in matters which have been examined and re-examined by people from different backgrounds, we are likely to find informations which are more dependable than in other matters.

The second consequence of the collective scientific skepticism is twofold, part amusing, part unfortunate. There are always people who are convinced that they have arrived at some important truths about one aspect of the world or another. They present their conclusions to the scientific community for acceptance, but may find, to their utter disappointment, that their proclamations are summarily rejected by scientific journals ; or if published, are coolly ignored. This is the all too common experience of thousands of scientific investigators the world over.

Now it may happen that the proponent of a new idea or discovery does have something important to say. He may really have accomplished a breakthrough in the frontiers of human knowledge. But his results were rejected either because of lack of sufficient interest in his field on the part of the vast majority of the scientific community, or because they were too complex and radical in their content. In any case, science as a human endeavour suffers.

In 1845, for example, James Prescott Joule presented a paper at the meeting of the British Association in Cambridge, entitled, "The Mechanical Equivalent of Heat." The paper was the outcome of seven years of dedicated work. But no interest was shown in his ideas. Joule did not give up. After further research and improvements of his experiments, he tried once again in 1847 to present the same ideas in Oxford. The Chairman of the meeting, who probably regarded Joule as a persistent pest, told him there were important matters on the agenda. However, he did allow Joule time for a brief oral account of his experiments. Once again, Joule's work would have gone unnoticed, for in Joule's own words, "...the communication would have passed without comment if a young man had not risen in this section, and by his intelligent observations created a lively interest in the new theory." The young man was William Thomson (later, Lord Kelvin).

Georg Mendel was not as fortunate when he published his work on heredity. His discoveries were to become part of standard scientific knowledge only several years after his death.

On the other hand, —and this happens more frequently— the person with the fresh idea may be talking pure nonsense. In such a case, the scientific community is merely spared the ordeal of reading the worthless material, let alone answering it, when the supposed contribution is rejected. The disappointed author may now follow one of two courses. He may try to marshal more evidence and argument for his thesis by further reflection and research. Or, he might compose a treatise on the narrow-mindedness of the scientific community or on the irrationality of the scientific enterprise and the unreliability of scientific knowledge.

Scientific skepticism then is particular rather than global : It vehemently doubts the truth value of every new item of knowledge that is presented for consideration ; but it fully believes that correct understanding of the nature of the world is well within human reach. □

EXPERT SYSTEMS

A. K. HALDER*

THIS article introduces the concept of an Expert System, a much talked about knowledge-based intelligent system and then describes PROLOG that has been adopted as the foundation language for the implementation of such a system. An Expert System will be a computer based system endowed with artificial intelligence. Its function will be mimic the reasoning behaviour of a human expert in solving problems in a specified field of knowledge (facts) such as a geologist prospecting for mineral deposits or an architect designing apartment blocks. But to build an efficient Expert System a new computer to process knowledge rather than numbers and a new method of inferential programming will be necessary. It is felt appropriate to discuss first why today's digital computer has been found inadequate to form the core of an Expert System.

Happy birthday Dear Computer

The electronic digital computer is approaching its fortieth birthday and it will be quite in order for reminiscing over the past achievements and crystal gazing into the future for the advent of even more spectacular computers. The computer of today has so far shown none of the signs of senility or of losing its vigour that usually comes with ageing ; on the contrary the computer has continued to gain in strength through the advancing years by acquiring larger data-handling capability and higher operating speed, and consequently, achieving greater computing power. True, some noticable changes have occurred during the period —the giant computer of the early sixties has shrunk in physical size, proliferated into our offices and entered our homes. Yet its original von Neumann architecture with the inherent design flaw and its primary function as a number cruncher have not changed at all. To design an Expert system what is needed is a non-numeric information handling machine capable of manipulating many Million Instructions Per Sec (MIPS).

von Neumann architecture

The von Neumann architecture consists of three fundamental parts : a central processing unit (CPU), a memory to store data and instructions ; and a central bus structure that can transmit one word at a time between the memory and the CPU or send one address at a time from the CPU to the memory. As a result, during program execution, only single words of information can pass one by one in a sequential manner through the bus ; so a new address to memory must be specified each step of the way for processing to be completed. This causes data 'bottlenecks' and adversely affects the execution speeds. Future hardware design must eliminate this bottleneck and a way out of this problem is the provision of a facility of parallel processing.

In the realm of computer software the technique of programming has changed remarkably little in the past and certain weaknesses persist. Virtually all existing programming languages which pattern themselves after von Neumann architecture are complex and in fficient. These languages are designed to control the way the computer processes and programmers need to be specially trained to devise the necessary algorithms. Evidently some radical changes in the computer architecture as well as a new programming style are called for. Think how much easier it would be for an average user (who is not a professional programmer) if he were able to instruct a computer in a natural language say, in English. A program will then become simply a formal statement of tasks. Such a natural programming language would be 'non-procedural' and quite different from a traditional language like Fortran. The programmer will supply the facts and the rules that describe his problem and an inference mechanism will be necessary in order to obtain a solution. It would be of advantage if the program itself could be considered as a set of procedures which, when executed, will perform a controlled deduction through the program statements. This is precisely what logic programming can achieve and PROLOG has the necessary ingredients including its built-in inference mechanism to be the candidate language of an Expert System.

---

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'Life begins at Forty' is a popular adage and is particularly applicable to the computer. Significant changes are already taking place in the organic structure of a computer in the form of a multi-CPU parallel architecture thanks to the developments in VLSI technology. In the software field logic programming will enable a computer, drawing on the store of knowledge, to make 'decisions'. Such a computer will be ideally suited to form the basis of an Expert System.

More on Expert System

An Expert System is a knowledge-based system that gives the computer the power to decide for itself what instructions or 'knowledge' are relevant to the solution of problems presented to it. It is the most important technique to emerge into practical application from the academic study of Artificial Intelligence. An Expert System can act intelligently (like a human) in a restricted but well defined field of knowledge. The famous MYCIN system developed at Stanford may be quoted as an example. It attempted to mimic the reasoning behaviour of a medical consultant in specialised fields of disease diagnosis and treatment and in a clinical trial MYCIN was found to be as good as any human in making inferences from the given facts (knowledge-base).

Intelligence

'Are we intelligent enough to understand human intelligence'? is a question that has bothered the thinking man through the ages. Now man tries to simulate intelligence in his created object—the computer. We may not agree on the true nature of intelligence but we accept that problem solving like mathematical theorem proving is an intelligent activity. If a computer system can be programmed for automatic problem solving (i.e. mechanical theorem proving) then the system surely has 'intelligence' and performs at human expert level. Therefore the system may be termed an Expert System. Such a system should have four capabilities :

(i) it can answer queries put to it ;
(ii) it can make diagnoses about situations and exercise control over them ;
(iii) it can display its line of reasoning leading to a conclusion that can easily be understood by a human ;
(iv) it can acquire new 'knowledge' in the process of solving a problem i.e. can infer new facts and rules about the problem.

To achieve these capabilities program statements need to be logic statements and the program should incorporate symbolic manipulation facility and a facility for program modification. Conventional programming language like Fortran does not meet these requirements. What we need is a rule-based language like the LISP. Recently PROLOG, more powerful than LISP in deriving logical inferences, has been developed and because of its logical properties PROLOG has been adopted by the Japanese for the 5th Generation Computer project on designing knowledge information processing systems. The following sections describe the structure and the power of PROLOG in information processing and in inferring a conclusion.

PROgramming in LOGic

It all started when Robinson described an algorithm for finding proofs of theorems in his famous 1965 JACM paper on automated inference based on resolution principle. Robinson's resolution principle proved attractive to researchers for applications involving symbol processing and simulation of intelligence. But we had to wait till 1972 when Colmerauer at the University of Marseilles successfully implemented Robinson's algorithm into a computer and used it for natural language processing. What Colmerauer had achieved was to create a machine with artificial intelligence which was able to perform a task generally regarded as an intelligent activity. At about the same time Kowalski of Edinburgh University showed that the Horn clause subset of predicate logic can be used as a programming language. The proof of a theorem in predicate logic can be regarded as a computation using Robinson's algorithm to perform the proof. Colmerauer's implementation of the algorithm was called PROLOG to signify that it was an efficient method of PROgramming in LOGic. Kowalski's work gave a solid theoretical and conceptual foundation to PROLOG and a new branch of computer science called Logic Programming emerged.

Predicate Logic

'amit likes labanya' is a statement in predicate logic that has a definitive truth value; TRUE or FALSE. The statement involves two 'argument's : amit and labanya ; and a relationship 'likes' that exists between an individual 'amit' and another 'labanya'. The relationship, called a predicate, has a specific order—'amit likes labanya' and we are not suggesting that labanya likes amit (perhaps quite rightly, since labanya may cherish a different feeling towards amit). Note that the word 'arguments' used above has only a programming connection and does not imply a dispute situation. We may leave it to labanya and amit to indulge in arguments over who likes the othermore.

PROLOG Language

A PROLOG programme is a collection of sentences similar to the one shown above but the sentences are transformed into formal, clausal form known as Horn clauses. A Horn clause expresses the given information which can be used to solve problems or to answer queries. An example of Horn clause is :

X is a female if X is a mother of Y.

In propositional logic it takes the form,

female (X) ← mother (X, Y). (mother (X, Y) implies female (X)). The 'arrow' is the logical connective "if" and female (X) is the conclusion while mother (X, Y) is the condition of the clause. In symbolic logic notation a Horn clause takes the form :

$A \leftarrow B_1$ AND B_2 AND.........AND B_n

Its equivalent expression is :

A OR (NOT B_1) OR (NOT B_2)........ OR (NOT B_n) and is logically TRUE.

Clearly a Horn clause contains at most one positive literal, the conclusion A, but may admit several conditions such as B_is.

PROLOG is a conversational language, the user carrying out a sort of dialogue with the computer. Programming in PROLOG consists of supplying :

(i) *facts* about objects and their relationships and

(ii) *rules* about how to deal with those facts ; and finally asking

(iii) *questions* about objects and their relationships.

A PROLOG system stores facts and rules and uses them to answer questions. The system works out the answer by making inferences from one fact to another and by generating new facts; indeed it has the capability of making deductive reasonings.

Facts

Some examples of PROLOG facts are:

likes (amit, labanya).

father (harihar, apu). (read as 'Harihar is the father of Apu')

brother (apu, durga).

In PROLOG the names of all relationships and objects must begin with a lowercase letter, e.g. likes, father, apu etc. All variables, however, begin with a capital letter, for example:

brother (X, durga). (PROLOG will search through the given database to match X to apu).

Rules

A PROLOG rule is a general statement about objects and their relationships and demonstrates that a fact depends on a number of other facts. The statement: likes (amit, X) :—female (X), likes (X, poetry) constitutes a rule. In plain English this rule states that amit likes any person X if X is a female *and* if X likes poetry. The clause shown to the left of the connective symbol ":—" (pronounced *if*) is called the 'head' of the rule and the clause shown on the right constitutes the 'body' of the rule. The body holds the goals of a problem to be solved.

Questions

PROLOG is a database query language. The database holds facts and some questions may be asked about them. A question consists of a question mark and a hyphen, followed by a clause, for example:

?—capital (dhaka, bangladesh). (Is Dhaka the capital of Bangladesh ?).

A Simple Program

This program has been chosen for the ease of understanding and is about family relationship.

Suppose we want to establish if Durga is the sister of someone. First, we define the clause: sister of (X, Y) is TRUE if X is a sister of Y. The following facts are supplied:

male (harihar)

male (apu)

female (sarbojaya)

female (durga)

parents (apu, harihar, sarbojaya)

parents (durga, harihar, sarbojaya)

The rule about 'sister of' is sister of

```
(X,Y) :— female (X), parents (X,F,M), parents (Y,F,M)
            goal 1      goal 2             goal 3
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The rule states that X is a sister of Y *if* X is a female and parents of X are F and M and parents of Y are also F and M where F = father, M = mother.

The appropriate question would be: ?—sister of (durga, X).

To solve the problem the three goals in the body of the rule must be satisfied in turn as descrided below.

The question matches the head of the rule. The variable X in the rule becomes 'instantiated' to durga and all X's in the rule are replaced by 'durga' and a new rule:

sister of (durga, Y) :—female (durga), parents (durga, F, M), parents (Y, F, M) is formed.

Variable X in the question and variable Y in this rule, however, remain as yet unknown.

(i) The first goal i.e. X must be a female succeeds as PROLOG by searching through the given facts establishes that durga is a female.

(ii) The second goal, parents (durga, F, M) is matched against the fact, parents (durga, harihar, sarbojaya). F becomes harihar and M becomes sarbojaya.

(iii) The new third goal is parents (Y, harihar, sarbojaya) which is matched against the fact parents (apu, harihar, sarbojaya) and it succeeds.

The variable Y becomes apu. Through pattern matching all the three goals have succeeded yielding X=durga and Y=apu. PROLOG will now print:

X=apu since X in the question is shared with variable Y in the rule. The above program illustrates the ease of writing statements in PROLOG.

In more complex problems, if an attempt to find a solution by 'pattern matching' fails, PROLOG will use 'backtracking' through the database to find alternative solutions. In general, problems to be solved are represented by clauses which are denials and PROLOG will use other clauses to try to refute the denial. A solution of the problem is obtained from the values of the variables which account for the refutation.

Epilogue

God created man after His own image and now man is attempting to create an intelligent system after his own image. This article is intended to stimulate interest in the design of an intelligent Expert System and in the study of the logic programming language PROLOG. By inventing the symbol '0' (Sunya) India in the past contributed significantly to the set of binary logical truth symbols. Let us hope in the coming years our researchers will make a greater contribution to the development of inferential logic programming and to the design of an intelligent knowledge-based system. □

ROYAL INSTITUTION OF GREAT BRITAIN

S. K. GUHA*

IN the world of science there are two "Royals" in science in Britain—The Royal Society (over 300 years old) and the Royal Institution which will complete two hundred years in 1999. Quite often visitors to London seemed to be confused between the two great learned institutions. It may be just mentioned that the former is a scientific society of highest repute holding scientific meetings and awarding Fellowship to the world famous scientists in recognition of their original contributions to science and technology whereas the Royal Institution is unique in its character for the various activities including researches carried out in its own laboratories since the days of the late Sir Humphrey Davy, the first Director of the Institution.

According to a resolution at a meeting presided over by Sir Joseph Banks at his house in Soho Square, on March 7, 1799, the Royal Institution of Great Britain was founded in the same year by Benjamin Thompson, Count Rumford—a native of Massachusetts. The purpose of founding this great Institution was clearly defined in the Managers' Minute Book as follows: "For diffusing the knowledge, and facilitating the general introduction of Useful Mechanical Inventions and Improvements; and for teaching by Courses of Philosophical Lectures and Experiments, the application of Science to the common Purposes of Life".

While the Institution was directed towards fulfilment of the above principal functions from the very beginning the activities mainly included researches in the present Davy Faraday Laboratory, Friday Evening Discourses for its members and later the famous Christmas Lectures for young people, started by Michael Faraday in 1826.

In the field of research there is probably no single laboratory in the world where discoveries, surpass in range and importance

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those made in the Davy Faraday Laboratory. To mention only a few among the discoveries to-date are the following :

(1) Discovery of electrical power ;
(2) Miner's safety lamp ;
(3) Liquefaction of gases ;
(4) Discovery of many new elements ;
(5) Alloy steels and
(6) Arc lamp.

Today, under the directorship of Sir George Porter, FRS, Nobelman, the main area of investigation is in photophysics and photochemistry with particular reference to the mechanism of biological photosynthesis. The Laboratory's investigation of very fast chemical reactions is internationally known and has improved the time resolution of flash techniques by a factor of million over what was possible a decade or two ago. Much research effort is now going into photochemical methods of storing solar energy and the Institution played a major role in founding The United Kingdom Section of the International Solar Energy Society.

The next important function and the most attractive feature of the Institution became the Friday Evening Discourses, with clear experimental demonstrations, by the resident Director and Professors of the Institution as well as by the outside scientists of repute for the diffusion of scientific knowledge among the public. Normally, these Discourses are held for the members of the Institution while each member was allowed to issue two visitors' cards for admission to the Discourses. Previously, admission to these lectures was free but today visitors and guests are charged differentially.

Next in importance is the annual series of Christmas Lectures, with demonstrations, for the juvenile audience. These lectures on popular scientific topics consist of, normally, a series of six lectures during the Christmas holidays. Faraday himself gave nineteen Christmas Lectures, the first one on 'Chemistry' in 1827 and the last one on 'The Chemical History of a Candle' in 1860. Even today the topics and the lectures are equally attractive. It is like a festival of science during the Christmas holidays each year. The writer, first as a visitor and then as a Member, had the opportunity of listening to both the Friday Evening Discourses and the Christmas Lectures during 1954 and 1972 in London. During the one hour long fascinating demonstration lectures every member of the audience remains spellbound.

In the early years Davy in his meteoric career had marked out the lines on which the Royal Institution was to develop. Faraday maintained and extended the traditions which his predecessor had established. Faraday's successors over the last century and nearly a quarter have not only maintained the same reputable traditions but have also extended further the activities of the Institution according to the needs of the day.

Before coming to the present-day activities it would be worthwhile to mention some of the great names who realized the dreams of the founder Count Rumford.

Early in 1801 Rumford, with the concurrence of the Managers, engaged as lecturer in Chemistry a certain young Cornishman Humphrey Davy, an apothecary's assistant, already known for his discovery of the anaesthetic properties of nitrous oxide, laughing gas. The minutes of the Managers record their decision on February 16 "that Mr. Humphrey Davy be engaged in the service of the Royal Institution in the capacities of Assistant Lecturer in Chemistry, Director of the Laboratory and Assistant Editor of the Journals of the Institution ; and that he be allowed to occupy a room in the house, and furnished with coals and candles ; and that he be paid a salary of one hundred guineas per annum". Later on Sir Humphrey Davy became one of the first in the line of famous Resident Professors who have guided the destinies of this great Institution.

Soon after the advent of Davy the next

famous name was Dr. Thomas Young, the newly appointed Professor of Natural Philosophy. Thomas Young became famous for his researches on the interference of light. His work was later extended by the French physicist Fresnel. Since then Young's reputation had steadily grown, and Young-Fresnel are jointly known internationally for their wave theory of light.

While Thomas Young worked for a short period of two years only Davy spent long years upto 1823 at the Institution. During this period Davy became world famous for the invention of Miners' Safety Lamp and his researches in electro-chemistry. His devotion to experimental work and his powers as a lecturer established Davy as a great scientist and as an expositor of scientific researches in layman's language with experimental illustrations. Since the days of Davy scientific researches and exposition became and have remained, the twin purposes of the existence of the Royal Institution.

The Institution's reputation was further enhanced since Sir Humphrey Davy appointed young Michael Faraday as his 'assistant' in 1813. His long training as assistant, first to Davy and afterwards to Prof. Brande, gave Faraday a wide knowledge of experimental chemistry and a remarkable degree of skill in handling the simple apparatus of the day. Through his continuous brilliant researches in chemistry and electricity Faraday became the first Fullerian Professor of Chemistry in 1833 and continued upto his retirement in 1867. During his long career Faraday established himself as a great scientist through his continuous discoveries in the field of chemistry and electro-magnetism. His discovery of the machine (dynamo) for electric power generation in 1831 made a great impact on the industrial revolution in Britain and also throughout the world. In 1931 Faraday Celebrations to do honour to the memory of the great man and his discovery attracted a remarkable international gathering of scientists and engineers in the lecture theatre of the Institution. During the same period, as mentioned earlier, Faraday made the Institution attractive and unique in character through his fascinating Friday Evening Discourses and Christmas Lectures.

Among the Professors of Natural Philosophy the successors of Dr. Thomas Young who made the Institution famous were John Tyndall (1853-1887), The Lord Rayleigh (1887-1905), Sir J. J. Thomson (1905-1920), The Lord Rutherford (1921-1937) and Sir Lawrence Bragg (1938-1953), who later on became the Fullerian Professor of Chemistry and Director of the Institution.

Since the retirement of Michael Faraday as Fullerian Professor of Chemistry and Director of the Institution in 1867 he was followed by the great men of science :

William Odling (1868-1873), John Hall Gladstone (1874-1877), Sir James Dewar (1877-1923), Sir William Bragg (1923-1942), Sir Henry Dale (1942-1946), Eric K. Rideal (1946-1949), Edward N. daC. Andrade (1950-1952), Sir Lawrence Bragg (1953-1966) and the present Director Sir George Porter (1966-).

As the writer had the pleasant opportunity of visiting the Royal Institution since March 1954 till October 1972 during the days of the late Sir Lawrence Bragg and Sir George Porter he had, besides listening to their marvellous demonstration lectures, witnessed the developments in the activities of the Institution during this period. Sir Lawrence Bragg introduced two important series of lectures viz., Schools Lectures since 1954, still continuing, and the Lectures for Civil Servants to educate the top civil servants in the potentialities and the applications of science—now not regularly held. His first series of Schools Lectures on "Some Famous Scientists at the Royal Institution" with demonstrations of their classical experiments attracted school children from all over the country and continued, like a film show, for more than a year or so. Among other things Sir George Porter has added the Photochemistry Discussion Group, Young Members' Group and Other Lectures like Mountbatten Lecture etc. Today the whole range of activities may be catalogued as follows:

Friday Evening Discourses
Christmas Lectures
Schools Lectures
Library Discussion Group
History of Science Discussion Group
Photochemistry Discussion Group
Group Visits
Young Members' Group and
Other Lectures.

While the Friday Evening Discourses and Christmas Lectures still remain the main features of the Institution, covering topics in all branches of science and technology, it is interesting to note that the lecturers for the above two series, though not paid any fee, feel honoured to be invited to deliver these lectures. Among the Indian scientists the late Sir J. C. Bose had the honour of delivering three Friday Evening Discourses during 1897 and 1903 on the results of his researches in electromagnetic waves and plant responses. In recent year, Prof. M. G. K. Menon delivered a memorial lecture on the late Dr. Homi J. Bhaba.

It may be mentioned here that all the above-mentioned research and academic activities are carried out today by the Professors (including the Director), and Readers supported by a number of devoted research workers, experimental officers, technicians, laboratory assistants and one workshop superintendent on the technical side. The current list includes seven Professors—one each in Astronomy, Chemistry, Experimental Medicine, Natural Philosophy, Physics and Physiology.

The Royal Institution has also been unique for its successful management in another aspect. Since its birth in 1799 the Institution has remained a solely private institution without any State grant. Membership subscriptions, private donations and endowments, and industrial grants are the sources of income. In this respect, our learned societies in India have enough to learn from the Managers of the Royal Institution. The Institution has been patronized by the Royal family since its inception in 1799—the present Patron is Her Majesty Queen Elizabeth II.

The Officers of the Institution include the President, the Treasurer one Secretary, fourteen Managers (of whom five are Vice-Presidents) and fourteen Visitors or the purpose of inspecting and examining the Institution, and the receipts and payments thereof and reporting thereon.

While it is known that our late Sir J. C. Bose founded the Bose Institute in 1917 on the model of the Royal Institution but, unfortunately, it has miserably failed to follow the pattern of Friday Evening Discourses for the diffusion of scientific knowledge through experimental demonstrations among the public.

Now that the Birla Industrial and Technological Museum is celebrating its Silver Jubilee during 1983-84 it is suggested that the same Museum—the first of its kind in India—may consider introducing at least an annual series of popular demonstration lectures similar to Christmas Lectures of the Royal Institution. In executing such programmes perhaps the Museum authorities may form an Advisory Committee drawing members from the organisations like Indian Science News Association, Indian Science Congress and Science Club, Calcutta, which are all engaged in the popularization of science and technology.

While stressing the importance of such popular lectures on science and technology in India it would be appropriate today to mention what Sir George Porter, during his last visit to Calcutta in January 1982, told a press reporter. According to the press report Sir George stressed that anyone who did not understand the spirit of science lead a very incomplete life. Non-scientific attitude harms progress.

Finally, how much devoted have been the successive Directors of the Royal Institution may be guessed from Sir George's plain statement that his domestic life is interesting for a rather special reason. Since he resides in the Royal Institution honoured by names such as Rumford, Humphrey Davy and Faraday he remarked, "I live with a lot of distinguished scientific ghosts". ☐

OBITUARY

G. K. CHAKRAVORTY

Late Prof. Girindra Kumar Chakravorty is no more among the zoologists. He passed away on 23rd May at the age of 81, leaving behind his only son and four daughters and many friends and admirers. His wife predeceased him. He obtained his both B. Sc. and M. Sc. degrees from the University of Calcutta and he stood first in the final M.Sc. examination (1928) and subsequently joined the University as a Lecturer in Zoology. He served this University in many capacities with distinction and honour. Those of us who received lessons in both basic zoology and helminthology from Girindra Kumar know how thorough he was in teaching and research. His grasp of the subject was clearly manifested in his editorial exercises for the Proceedings of the Zoological Society of Bengal for a longer period of the Society's history. It is needless to say that the Proceedings received wide appreciation throughout India and abroad because of his untiring efforts and meticulous skill.

As a man Girindra Kumar was humble, dignified and won both love and admiration from his students, colleagues and non-teaching employees. No administrative or academic problem was an issue to him. He could solve those quite easily without hurting anybody's feelings and sentiments. On retirement from the services of the University of Calcutta he joined the Dantan College, Midnapore, as an administrator.

Girindra Kumar will be remembered by the future zoologists for his notable contributions in the field of systematic helminthology for which he never clamoured for fund or equipments. He had an excellent record of highly productive years during 1936-48 when he was engaged on the characterization of helminths from the common fishes, birds and mammals. He had an unusually rare virtue in his sincerity, persistence and search for classical beauty in natural events. ☐

S. G. Pal

NOTES & NEWS

Peaceful uses of Nuclear Energy

Programme of Department of Atomic Energy of India (1983-84)

Nuclear Power Programme :

As a result of consistent efforts towards self-reliance India is today one of the few countries in the world, and the only one among the developing countries, to attain self-reliance in all aspects of nuclear power generation, starting from prospecting and mining of uranium to fuel reprocessing and waste management as well as plutonium recycle. As the only viable alternative, in the foreseeable future, to fossil fuel based power, a target of 10,000 MW for establishing the nuclear power generation capacity by the year 2000 has been set, constituting about 10 per cent of total power generation capacity in the country at that time. The necessary capabilities to attain this target have been built by the Department with the cooperation of industry. Indigenous design of 235 MWe pressurised heavy water reactors (PHWRs) has been standardised and these, along with indigenous 500 MWe PHWRs a little later, will provide the backbone of the programme. Necessary inputs such as uranium and heavy water will also be made available within the country.

The nuclear power generation capacity increased to 1095 MWe with Unit 1 of MAPP beginning commercial operation on January 27, 1984. During 1983-84 the revenue earnings of Government from the sale of electricity from the nuclear power reactors amounted to Rs. 116.90 crores.

Tarapur Atomic Power Station :

TAPS completed 14 years of operation and achieved a cumulative capacity factor of over 50 per cent. The Station generated 1554 million units of power upto the end of 1983, supplying 720 million units of Maharashtra and 706 million units to Gujarat. The first consignment of enriched uranium from France was received in May 1983. Concerted efforts are being made to indigenously manufacture and procure spare parts for the plant from alternative suppliers.

Rajasthan Atomic Power Station :

After generating 5872 million units of power since, it began commercial operation, Unit 1 of RAPS was shut down in March 1982 due to cooling water (light water) leakage from its south end shield. Considerable original work in problem identification was carried out to determine the nature and extent of the defect and related solutions and investigations are being continued to solved the problem.

Unit 11 of RAPS maintained its reliable performance operating at about 185 MWe and generating 863 million units of power until December 1983, thus meeting 18 per cent of the total power consumption of Rajasthan State. The Unit also supplied steam equivalent to 10 MWe power generation to the Heavy Water Plant, Kota.

Madras Atomic Power Project :

Unit 1 of MAPP attained criticality on July 2, 1983 and was synchronised to the grid on July 23, 1983. The unit has performed very well and began commercial operation from January 27, 1984 steadily generating over 200 MWe. Unit 11 of MAPP is nearing completion and is expected to become operational early in 1985.

Narora Atomic Power Project :

Reactor and turbine buildings for Unit 1 have been completed while those for Unit 11 are nearing completion. Construction of various facilities and installation of equipment and piping is progressing. The units are scheduled to be completed in 1987-88 and 1988-89 respectively.

Kakrapar Atomic Power Project :

Work on the site infrastructure and procurement and fabrication of critical components is in progress. The two units are expected to be commissioned in 1991 and 1992 respectively.

Heavy Water Programme :

Considerable progress was made during the year towards attaining self-sufficiency in heavy water which is the moderator and coolant for the Pressurised Heavy Water Reactors (PHWRs). The heavy water plants at Baroda and Tuticorin have been operating continuously for the last five months. Most of the earlier teething problems encountered in the heavy water programme have been overcome. The heavy water plant at Kota is expected to complete its commissioning trials by the end of October 1984. Work on new heavy water plants at Thal-Vaishet of 110 tonnes per year effective capacity, based on monothermal ammoniahydrogen exchange process and at Manuguru of 185 tonnes per year effective capacity based on hydrogen-sulphide water exchange process proceeded according to schedule. The commissioning activities of the Heavy Water Plant at Talcher were however delayed mainly due to power cuts, erratic supplies of ammonia gas from fertilizer plants and some technical problems.

Attempts are being made to make ammonia based plants independent of the fertilizer plants. A pilot plant set up at Baroda will be trying a new process in this regard. Testing and commissioning trails of this plant are nearing completion.

Heavy Water Upgrading :

Heavy water upgrading plants have been designed and engineered by BARC. The first heavy water and vacuum distillation plant was commissioned satisfactorily at RAPS in September 1982 and from the very first month it exceeded design capacity. The electrolysis based heavy water upgrading plant has been operating satisfactorily at MAPP since March 1981. Work on the design and setting up of new upgrading plants is progressing.

Nuclear Fuel Complex :

The Nuclear Fuel Complex (NFC) at Hyderabad continued to manufacture, fuel and zircaloy structural materials for nuclear power reactors.

The value of production achieved for the fuels and Tubes Groups of NFC till December 1983 was of the order of Rs. 18.62 crores.

NFC expansion phase I, aimed at doubling the out put, has also been taken up.

Atomic Minerals Division :

The Atomic Minerals Division (AMD) continued its integrated surveys and exploration for appraisal and building up of uranium and other nuclear raw material resources. During the year the input in exploratory drilling was considerably augmented and fresh radioactivity anomalies were identified in parts of Karnataka, Madhya Pradesh, Meghalaya, Himachal Pradesh, Uttar Pradesh, Rajasthan as well as additional uranium reserves in the Singbhum Thrust Belt of Bihar. As a result, total indicated and inferred reserves of about 73,000 tonnes of U_3O_8 have been established in different parts of the country.

Indian Rare Earths Limited :

Registered in 1950, with an authorised capital of Rs. 1 crore, Indian Rare Earths Limited (IRE) has been operating a plant at Alwaye, in Kerala to process monazite from beach sands, two minor sand separator plants at Manavalakuruchi, in Tamil Nadu and Chavara, in Kerala and a Thorium Plant at Trombay, IRE is also setting up at Chhatrapur, Orissa, the Sands, Complex (OSCOM). The Company is a major exporter of rare earths and minerals.

During the year 1982-83, IREs sales turnover was Rs. 16.47 crores, registering an increase of 21.5 per cent. IRE made a net profit of Rs. 1.39 crores, an increase of 34 per cent over the previous year. The company has been paying dividends to the Government for the last two decades.

Uranium Corporation of India Ltd. :

Registered in 1967, with an authorised capital of Rs. 15 crores, the Uranium Corporation of India Ltd, undertakes mining and milling of uranium ores on magnetite and copper concentrates as by-products. UCIL also produces sulphuric acid mostly for its own consumption.

Under UCIL expansion programme, the plant at Rakha for uranium recovery from copper tailings was commissioned in February 1983. Project report for setting up another uranium recovery plant at Mosabani has been finalised. The new Bhatin mines project is expected to be completed in about three years. Project reports for Narwapahar and Turamdih projects are under preparation. During 1983-84, the production of uranium concentrate was highest since the commencement of operations in 1968. The overall capacity utilisation in terms of production of uranium concentrate was 97.7 per cent and the quantum of ore mined and processed was higher than the previous year.

UCIL earned profit during 1982-83 and contributed to the exchequer Rs. 57.47 lakhs by way of duties etc.

Electronics Corporation of India Ltd. :

The Electronics Corporation of India Ltd. (ECIL) was incorporated in 1967 with an authorised capital of Rs. 10 crores to take up commercial production of Nuclear electronic instruments, components and equipment developed by BARC and TIFR. Later the Corporation diversified its production and established itself in various fields such as communication, instrumentation, nuclear and consumer electronics.

ECIL maintained steady progress during 1983-84 in major thrust areas. The production of the most powerful Indian built computer system-332 has been stabilized.

During the year 1982-83 ECIL's production was Rs. 60.47 crores and net profit of Rs. 2.13 crores was earned.

Nuclear Safety:

During 1983-84 the Department's plants continued their good safety record. The safety status of the plants remained under continuous review by the Safety Review Committee. An Atomic Energy Regulatory Board was established during the year to carry out certain regulatory and safety functions envisaged in the Atomic energy Act.

International Relations:

India was once again designated to the IAEA Board of Governors as one of the globally most advanced states in the technology of atomic energy including the production of source materials. India continued to cooperate with other countries, particularly developing countries, in peaceful uses of atomic energy. □

Nuclear India

New material for utilising solar energy

A new material which absorbs the sun's energy and transmits it with a greater degree of efficiency than has been known till recently has been developed at the Hebrew University of Jerusalem, Israel.

The material, a combination of plastic and glass components, uses 30% of the solar energy which it absorbs. The nature of the new material is such that it can concentrate a large quantity of light on a small area and, therefore, would require only a small amount of solar cells in order to turn solar energy into electricity. By connecting solar cells to surfaces of the material, solar energy can be converted into electricity for home or industrial utility. At the same time, it is also possible to attach optical fibres to the material and thus employ solar energy for operating telephones and computers.

The cost of electricity derived from this material will be 10-30 times cheaper than solar energy now obtainable from solar cells and will be equivalent to the cost of conventionally-generated electricity. It is already worthwhile to enclose roofs and terraces with this new material instead of glass. The material will be most efficient in multistory structures, especially office buildings with a large number of communication lines and computer systems. □

News from Israel

Biology and propagation of *Gelidiella acerosa*

At the Central Salt & Marine Chemicals Research Institute's Marine Algal Research Station, Mandapam, the growth of *Gelidiella acerosa* in two different ecological habitats in the Mandapam region and certain external factors controlling the agar production were studied.

The researcher P. V. Subba Rao observed a conspicuous peak in vegetative growth for the alga following summer months. The alga propagates itself vegetatively, although tetrasporic plants are fairly common. Two growth forms of the alga existed in the Mandapam area, corresponding to the open shore at Ervadi and lagoon at Rameswaram; this was supported by reverse transplants. Compared to the Rameswaram plants, the Ervadi population was distinctly more productive in respect of bushiness, percentage cover, growth rate, population biomass and half-yearly life-cycles. However, the agar traits did not show significant differences. The maximum agar production was delayed after the peak period of vegetative growth in the lagoon habitat and was concurrent with the growth peak in the open shore.

Based on the chromosomal number, the Ervadi population was classified under separate cytotype. The open-shore form appeared to be evolved as an adaptation to the environment, exhibiting phenotype differences in the number and advanced type of branch systems. Pre-treatments with growth regulators enhanced algal growth in field-cultivation experiments. The effective type and concentration of growth regulators were ascertained.

The study of the regrowth of differentially harvested populations at bimonthly intervals indicated the existence of a short recovery period under moderate harvest. A harvesting schedule for the alga was drawn based on these observations. □

CSIR News

Hope for Leukaemia sufferers

Australian scientists have made an important development in genetic engineering which offers new hope for the understanding and treatment of leukaemia.

Two research teams from the John Curtin School of Medical Research at the Australian National University, Canberra, have successfully cloned the gene vital for the reproduction of blood cells. They have isolated the gene in mouse cells and are optimistic that they can now isolate the corresponding gene in humans. The cloning of the gene, called interleukin-3, also marks the beginning of a new area in research on the factors which regulate the formation of the different blood cells from stem cells in bone marrow.

Leukaemia, once an incurable cancer, is characterised by an uncontrolled proliferation of white blood cells. Patients with severe leukaemia can be treated with cytoloxic drugs. These kill both the leukaemic cells and normal bone marrow cells from which they are derived. This often results in the need for bone-marrow transplantation. In the short-term, the isolation of human interleukin-3 would be valuable in speeding up the recovery of patients with bone-marrow transplants. In the longer term, the discovery offered for the first time a "handle on the mechanism" by which white blood cells proliferate.

Transplant patients now are left for a long period without adequate white blood cells to ward off infection. It might be possible that some people suffering from leukaemia could have their own healthy bone-marrow cells grown in the laboratory and injected back to replace diseased marrow. □

Australian Information Service

Satellites helps to eradicate disease

Mustering cattle with satellites helps Australian agricultural experts pinpoint areas of the country hiding undetected cattle.

Landsat IV satellite imagery is one of the latest tools contributing to continent's national survey of its cattle in a campaign in eradicate bovine tuberculosis and brucellosis. Australia hopes to get rid of both diseases by 1993. One or other of these diseases now infects 10% of nation's herds, placing about 3.6 million cattle at risk of contamination.

The difficulty of mustering cattle for herd testing is the biggest obstacle facing the eradication program in northern Australia.

Using Landsat, Peter Laut of CSIRO, has developed a method to estimate how much of the northern cattle country fits into specially defined categories of mustering difficulty. He examined the range of landscape types and their extent and approximate distribution so that the Bureau of Animal Health could accurately estimate the costs involved in a clean muster. His study area extended to cattle stations in the rugged country in the north and included the Kimberleys of northern part of Western Australia and the tall grasslands of the Nothern Territory inhabited by water buffalo. He used the

1 : 500,000 Landsat images to identify six types of vegetation in the study area. Linking the previously published map data with corresponding Landsat images, he estimated what proportions of each 4 km^2 and 100 km^2 cell were easy or difficult to muster, in terms of vegetation and land forms.

The Bureau of Animal Health will use Laut's results to develop a more accurate estimate of the cost of the mustering required to complete the TB eradication programme. In areas where mustering would be too costly search destroy operations, using helicopter-borne marksmen, will probably have to be implemented ☐

Australian Information Service

Absence of sunlight linked with bone fractures

Elderly men and women who spend most of their time indoors, away from sunlight, appear to run a high risk of bone fractures. Vitamin D, which is essential for healthy bones, is produced in the body when the skin is in light.

A team of medical scientists from South Australia reported to an international symposium on bone disease held in Adelaide that evidence existed to suggest that lack of sunlight—the body's main source of Vitamin D—contributed to a high incidence of hip fractures in the 70-80 age group. Vitamin D is needed for bones to take up calcium and Phosphorus—minerals which are essential for bone growth and stability.

The team, from the South Australian Institute of Medical and Veterinary Science and the Royal Adelaide Hospital, after examining "household" patients in a large metropolitan nursing home, said that they had found very low levels of Vitamin D in comparison with another group of the same age who often went outdoors and whose vitamin D levels were normal. Examinations of a third group of patients admitted to hospital with hip fractures revealed that they had very low levels of the vitamin.

The scientists remarked that they intended to investigate the possibility of recommending to public-health authorities that they regularly expose elderly people to sunlight or give them vitamin D supplements. ☐

Australian Information Service

V. WATER-SUPPLY AND DRAINAGE

WATER-SUPPLY AND DRAINAGE FOR CALCUTTA

(Key-note Address)

R. B. CHAKRAVARTY

ON the subject matter before this session, the question of population appears to be the most important. This matter would however be deliberated in another session and we need not go into details of it. Water-supply will have a direct bearing on this matter, while storm-drainage will have only marginal effect due to increase in population, unless the area is increased. The sanitary drainage, or the dry weather flow, will increase proportionately with the population but in the combined system of drainage this would not cause any difficulty.

Water-Supply

To appreciate the situation beyond 2000 A. D., it would be necessary to ascertain the present and projected arrangements. It is known that the water-works for Calcutta are located at Palta. River water is pumped into 4 settling tanks (after alum treatment) and the presettled water is taken through a vast sedimentation basin (constructed in 1926), on to the slow sand filter beds. These beds were constructed in stages from 1868 to 1926, (totalling 59 in number) having a gross capacity of 99 MGD, out of which about 15% may not be available due to maintenance works and other difficulties. In 1948 a Rapid Gravity Filter (18 MGD) was installed which is also supplied from the sedimentation basin, taking the useful capacity to 100 MGD. In the 'sixties', a 60-MGD unit of Rapid Gravity Filter was installed with Clariflocculator plants attached. A few of the slow-sand filter beds were dismantled to accommodate the installation of some other clariflocculators for supplementing the supply to the slow-sand filter beds. The net capacity is thus somewhat less than 160 MGD. There is arrangement for chlorination of the filtered water at Palta.

The filtered water is then pumped to Tala ground reservoirs through four pipes (42" – CI, 48" – CI, 60" – MS and 72" – MS-cathodically protected), having a total capacity of 176 MGD. (The 60" pipe is badly corroded and a new cathodically protected 60" pipe is being installed to replace the old one). There are three ground reservoirs at Tala, each having its own pumping station. The pumps supply water direct into the distribution system during peak hours, while a major part of pumping capacity is utilised to pump the water to the overhead reservoir, which supplements the peak hour needs.

The distribution system consists of Zone-Mains meant for different areas. On account of intermediate tappings (probably not in the original planning), the pressure in distant places (like Kalighat, etc.) is reduced. To overcome this difficulty an underground reservoir has been constructed at Aukland Square for storage during non-peak hours, to be pumped into the Mains during peak hours. Also for the same reason the underground tank at Subodh Mullick Square has also been renovated and fitted with a pumping system.

With the construction of the Barrage at Farakka, it has been practicable to set up new water-works at Garden Reach. This system is to have a total capacity of 60 MGD but is meant for other adjoining areas in addition to Calcutta area. There is some proposal for augmenting the capacity of Palta Works but this is for meeting the needs are subjected to pitiless dissection by the whole body of experts in the field before they are even given a provisional hearing. This inevitable fate of his findings encourages, indeed compels, the ardent scientific searcher to think twice, indeed twenty times, before he presents his findings to the scientific community at large.

The cold-blooded skepticism of the scientific community vis-a-vis the findings of any single one of its members has two major consequences : one positive, and the other, not quite so. First, because of the checking and re-checking that go into play before conclusions are reached, because of the detailed scrutiny to which a new idea is subjected, because, in short, of the extreme caution which the scientist is obliged to exercise in his professional activity, facts and comments that the world of science enunciates are relatively more reliable than those emanating from other sources. This is not to say that scientists cannot err, or that they may not be ignorant of facets of the world yet unexplored. But what does seem reasonable is that in matters where disinterested people have probed, in matters which have been examined and re-examined by people from different backgrounds, we are likely to find informations which are more dependable than in other matters.

The second consequence of the collective scientific skepticism is twofold, part amusing, part unfortunate. There are always people who are convinced that they have arrived at some important truths about one aspect of the world or another. They present their conclusions to the scientific community for acceptance, but may find, to their utter disappointment, that their proclamations are summarily rejected by scientific journals ; or if published, are coolly ignored. This is the all too common experience of thousands of scientific investigators the world over.

Now it may happen that the proponent of a new idea or discovery does have something important to say. He may really have accomplished a breakthrough in the frontiers of human knowledge. But his results were rejected either because of lack of sufficient interest in his field on the part of the vast majority of the scientific community, or because they were too complex and radical in their content. In any case, science as a human endeavour suffers.

In 1845, for example, James Prescott Joule presented a paper at the meeting of the British Association in Cambridge, entitled, "The Mechanical Equivalent of Heat." The paper was the outcome of seven years of dedicated work. But no interest was shown in his ideas. Joule did not give up. After further research and improvements of his experiments, he tried once again in 1847 to present the same ideas in Oxford. The Chairman of the meeting, who probably regarded Joule as a persistent pest, told him there were important matters on the agenda. However, he did allow Joule time for a brief oral account of his experiments. Once again, Joule's work would have gone unnoticed, for in Joule's own words, "...the communication would have passed without comment if a young man had not risen in this section, and by his intelligent observations created a lively interest in the new theory." The young man was William Thomson (later, Lord Kelvin).

Georg Mendel was not as fortunate when he published his work on heredity. His discoveries were to become part of standard scientific knowledge only several years after his death.

On the other hand, —and this happens more frequently— the person with the fresh idea may be talking pure nonsense. In such a case, the scientific community is merely spared the ordeal of reading the worthless material, let alone answering it, when the supposed contribution is rejected. The disappointed author may now follow one of two courses. He may try to marshal more evidence and argument for his thesis by further reflection and research. Or, he might compose a treatise on the narrow-mindedness of the scientific community or on the irrationality of the scientific enterprise and the unreliability of scientific knowledge.

Scientific skepticism then is particular rather than global: It vehemently doubts the truth value of every new item of knowledge that is presented for consideration; but it fully believes that correct understanding of the nature of the world is well within human reach. ☐

EXPERT SYSTEMS

A. K. HALDER*

THIS article introduces the concept of an Expert System, a much talked about knowledge-based intelligent system and then describes PROLOG that has been adopted as the foundation language for the implementation of such a system. An Expert System will be a computer based system endowed with artificial intelligence. Its function will be mimic the reasoning behaviour of a human expert in solving problems in a specified field of knowledge (facts) such as a geologist prospecting for mineral deposits or an architect designing apartment blocks. But to build an efficient Expert System a new computer to process knowledge rather than numbers and a new method of inferential programming will be necessary. It is felt appropriate to discuss first why today's digital computer has been found inadequate to form the core of an Expert System.

Happy birthday Dear Computer

The electronic digital computer is approaching its fortieth birthday and it will be quite in order for reminiscing over the past achievements and crystal gazing into the future for the advent of even more spectacular computers. The computer of today has so far shown none of the signs of senility or of losing its vigour that usually comes with ageing; on the contrary the computer has continued to gain in strength through the advancing years by acquiring larger data-handling capability and higher operating speed, and consequently, achieving greater computing power. True, some noticable changes have occurred during the period —the giant computer of the early sixties has shrunk in physical size, proliferated into our offices and entered our homes. Yet its original von Neumann architecture with the inherent design flaw and its primary function as a number cruncher have not changed at all. To design an Expert system what is needed is a non-numeric information handling machine capable of manipulating many Million Instructions Per Sec (MIPS).

von Neumann architecture

The von Neumann architecture consists of three fundamental parts: a central processing unit (CPU), a memory to store data and instructions; and a central bus structure that can transmit one word at a time between the memory and the CPU or send one address at a time from the CPU to the memory. As a result, during program execution, only single words of information can pass one by one in a sequential manner through the bus; so a new address to memory must be specified each step of the way for processing to be completed. This causes data 'bottlenecks' and adversely affects the execution speeds. Future hardware design must eliminate this bottleneck and a way out of this problem is the provision of a facility of parallel processing.

In the realm of computer software the technique of programming has changed remarkably little in the past and certain weaknesses persist. Virtually all existing programming languages which pattern themselves after von Neumann architecture are complex and inefficient. These languages are designed to control the way the computer processes and programmers need to be specially trained to devise the necessary algorithms. Evidently some radical changes in the computer architecture as well as a new programming style are called for. Think how much easier it would be for an average user (who is not a professional programmer) if he were able to instruct a computer in a natural language say, in English. A program will then become simply a formal statement of tasks. Such a natural programming language would be 'non-procedural' and quite different from a traditional language like Fortran. The programmer will supply the facts and the rules that describe his problem and an inference mechanism will be necessary in order to obtain a solution. It would be of advantage if the program itself could be considered as a set of procedures which, when executed, will perform a controlled deduction through the program statements. This is precisely what logic programming can achieve and PROLOG has the necessary ingredients including its built-in inference mechanism to be the candidate language of an Expert System.

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'Life begins at Forty' is a popular adage and is particularly applicable to the computer. Significant changes are already taking place in the organic structure of a computer in the form of a multi-CPU parallel architecture thanks to the developments in VLSI technology. In the software field logic programming will enable a computer, drawing on the store of knowledge, to make 'decisions'. Such a computer will be ideally suited to form the basis of an Expert System.

More on Expert System

An Expert System is a knowledge-based system that gives the computer the power to decide for itself what instructions or 'knowledge' are relevant to the solution of problems presented to it. It is the most important technique to emerge into practical application from the academic study of Artificial Intelligence. An Expert System can act intelligently (like a human) in a restricted but well defined field of knowledge. The famous MYCIN system developed at Stanford may be quoted as an example. It attempted to mimic the reasoning behaviour of a medical consultant in specialised fields of disease diagnosis and treatment and in a clinical trial MYCIN was found to be as good as any human in making inferences from the given facts (knowledge-base).

Intelligence

'Are we intelligent enough to understand human intelligence'? is a question that has bothered the thinking man through the ages. Now man tries to simulate intelligence in his created object—the computer. We may not agree on the true nature of intelligence but we accept that problem solving like mathematical theorem proving is an intelligent activity. If a computer system can be programmed for automatic problem solving (i.e. mechanical theorem proving) then the system surely has 'intelligence' and performs at human expert level. Therefore the system may be termed an Expert System. Such a system should have four capabilities :

(i) it can answer queries put to it ;
(ii) it can make diagnoses about situations and exercise control over them ;
(iii) it can display its line of reasoning leading to a conclusion that can easily be understood by a human ;
(iv) it can acquire new 'knowledge' in the process of solving a problem i.e. can infer new facts and rules about the problem.

To achieve these capabilities program statements need to be logic statements and the program should incorporate symbolic manipulation facility and a facility for program modification. Conventional programming language like Fortran does not meet these requirements. What we need is a rule-based language like the LISP. Recently PROLOG, more powerful than LISP in deriving logical inferences, has been developed and because of its logical properties PROLOG has been adopted by the Japanese for the 5th Generation Computer project on designing knowledge information processing systems. The following sections describe the structure and the power of PROLOG in information processing and in inferring a conclusion.

PROgramming in LOGic

It all started when Robinson described an algorithm for finding proofs of theorems in his famous 1965 JACM paper on automated inference based on resolution principle. Robinson's resolution principle proved attractive to researchers for applications involving symbol processing and simulation of intelligence. But we had to wait till 1972 when Colmerauer at the University of Marseilles successfully implemented Robinson's algorithm into a computer and used it for natural language processing. What Colmerauer had achieved was to create a machine with artificial intelligence which was able to perform a task generally regarded as an intelligent activity. At about the same time Kowalski of Edinburgh University showed that the Horn clause subset of predicate logic can be used as a programming language. The proof of a theorem in predicate logic can be regarded as a computation using Robinson's algorithm to perform the proof. Colmerauer's implementation of the algorithm was called PROLOG to signify that it was an efficient method of PROgramming in LOGic. Kowalski's work gave a solid theoretical and conceptual foundation to PROLOG and a new branch of computer science called Logic Programming emerged.

Predicate Logic

'amit likes labanya' is a statement in predicate logic that has a definitive truth value, TRUE or FALSE. The statement involves two 'argument's : amit and labanya ; and a relationship 'likes' that exists between an individual 'amit' and another 'labanya'. The relationship, called a predicate, has a specific order—'amit likes labanya' and we are not suggesting that labanya likes amit (perhaps quite rightly, since labanya may cherish a different feeling towards amit). Note that the word 'arguments' used above has only a programming connection and does not imply a dispute situation. We may leave it to labanya and amit to indulge in arguments over who likes the othermore.

PROLOG Language

A PROLOG programme is a collection of sentences similar to the one shown above but the sentences are transformed into formal, clausal form known as Horn clauses. A Horn clause expresses the given information which can be used to solve problems or to answer queries. An example of Horn clause is :

X is a female if X is a mother of Y.

In propositional logic it takes the form,

female (X) ← mother (X, Y). (mother (X, Y) implies female (X)). The 'arrow' is the logical connective "it" and female (X) is the conclusion while mother (X, Y) is the condition of the clause. In symbolic logic notation a Horn clause takes the form :

$$A \leftarrow B_1 \text{ AND } B_2 \text{ AND} \ldots\ldots\ldots \text{AND } B_n$$

Its equivalent expression is :

$$A \text{ OR } (\text{NOT } B_1) \text{ OR } (\text{NOT } B_2) \ldots\ldots\ldots \text{ OR } (\text{NOT } B_n)$$ and is logically TRUE.

Clearly a Horn clause contains at most one positive literal, the conclusion A, but may admit several conditions such as B_is.

PROLOG is a conversational language, the user carrying out a sort of dialogue with the computer. Programming in PROLOG consists of supplying :

(i) *facts* about objects and their relationships and

(ii) *rules* about how to deal with those facts ; and finally asking

(iii) *questions* about objects and their relationships.

A PROLOG system stores facts and rules and uses them to answer questions. The system works out the answer by making inferences from one fact to another and by generating new facts; indeed it has the capability of making deductive reasonings.

Facts

Some examples of PROLOG facts are:

likes (amit, labanya).

father (harihar, apu). (read as 'Harihar is the father of Apu')

brother (apu, durga).

In PROLOG the names of all relationships and objects must begin with a lowercase letter, e.g. likes, father, apu etc. All variables, however, begin with a capital letter, for example:

brother (X, durga). (PROLOG will search through the given database to match X to apu).

Rules

A PROLOG rule is a general statement about objects and their relationships and demonstrates that a fact depends on a number of other facts. The statement: likes (amit, X) :—female (X), likes (X, poetry) constitutes a rule. In plain English this rule states that amit likes any person X if X is a female *and* if X likes poetry. The clause shown to the left of the connective symbol ":—" (pronounced *if*) is called the 'head' of the rule and the clause shown on the right constitutes the 'body' of the rule. The body holds the goals of a problem to be solved.

Questions

PROLOG is a database query language. The database holds facts and some questions may be asked about them. A question consists of a question mark and a hyphen, followed by a clause, for example:

?—capital (dhaka, bangladesh). (Is Dhaka the capital of Bangladesh ?).

A Simple Program

This program has been chosen for the ease of understanding and is about family relationship.

Suppose we want to establish if Durga is the sister of someone. First, we define the clause: sister of (X, Y) is TRUE if X is a sister of Y. The following facts are supplied:

male (harihar)

male (apu)

female (sarbojaya)

female (durga)

parents (apu, harihar, sarbojaya)

parents (durga, harihar, sarbojaya)

The rule about 'sister of' is sister of (X,Y) :—female (X), parents (X,F,M), parents (Y,F,M)

goal 1 goal 2 goal 3

The rule states that X is a sister of Y *if* X is a female and parents of X are F and M and parents of Y are also F and M where F = father, M = mother.

The appropriate question would be: ?— sister of (durga, X).

To solve the problem the three goals in the body of the rule must be satisfied in turn as descrided below.

The question matches the head of the rule. The variable X in the rule becomes 'instantiated' to durga and all X's in the rule are replaced by 'durga' and a new rule:

sister of (durga, Y) :—female (durga), parents (durga, F, M), parents (Y, F, M) is formed.

Variable X in the question and variable Y in this rule, however, remain as yet unknown.

(i) The first goal i.e. X must be a female succeeds as PROLOG by searching through the given facts establishes that durga is a female.

(ii) The second goal, parents (durga, F, M) is matched against the fact, parents (durga, harihar, sarbojaya). F becomes harihar and M becomes sarbojaya.

(iii) The new third goal is parents (Y, harihar, sarbojaya) which is matched against the fact parents (apu, harihar, sarbojaya) and it succeeds.

The variable Y becomes apu. Through pattern matching all the three goals have succeeded yielding X=durga and Y=apu. PROLOG will now print:

X=apu since X in the question is shared with variable Y in the rule. The above program illustrates the ease of writing statements in PROLOG.

In more complex problems, if an attempt to find a solution by 'pattern matching' fails, PROLOG will use 'backtracking' through the database to find alternative solutions. In general, problems to be solved are represented by clauses which are denials and PROLOG will use other clauses to try to refute the denial. A solution of the problem is obtained from the values of the variables which account for the refutation.

Epilogue

God created man after His own image and now man is attempting to create an intelligent system after his own image. This article is intended to stimulate interest in the design of an intelligent Expert System and in the study of the logic programming language PROLOG. By inventing the symbol '0' (Sunya) India in the past contributed significantly to the set of binary logical truth symbols. Let us hope in the coming years our researchers will make a greater contribution to the development of inferential logic programming and to the design of an intelligent knowledge-based system. □

ROYAL INSTITUTION OF GREAT BRITAIN

S. K. GUHA*

IN the world of science there are two "Royals" in science in Britain—The Royal Society (over 300 years old) and the Royal Institution which will complete two hundred years in 1999. Quite often visitors to London seemed to be confused between the two great learned institutions. It may be just mentioned that the former is a scientific society of highest repute holding scientific meetings and awarding Fellowship to the world famous scientists in recognition of their original contributions to science and technology whereas the Royal Institution is unique in its character for the various activities including researches carried out in its own laboratories since the days of the late Sir Humphrey Davy, the first Director of the Institution.

According to a resolution at a meeting presided over by Sir Joseph Banks at his house in Soho Square, on March 7, 1799, the Royal Institution of Great Britain was founded in the same year by Benjamin Thompson; Count Rumford—a native of Massachusetts. The purpose of founding this great Institution was clearly defined in the Managers' Minute Book as follows: "For diffusing the knowledge, and facilitating the general introduction of Useful Mechanical Inventions and Improvements; and for teaching by Courses of Philosophical Lectures and Experiments, the application of Science to the common Purposes of Life".

While the Institution was directed towards fulfilment of the above principal functions from the very beginning the activities mainly included researches in the present Davy Faraday Laboratory, Friday Evening Discourses for its members and later the famous Christmas Lectures for young people, started by Michael Faraday in 1826.

In the field of research there is probably no single laboratory in the world where discoveries, surpass in range and importance

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those made in the Davy Faraday Laboratory. To mention only a few among the discoveries to-date are the following :

(1) Discovery of electrical power ;
(2) Miner's safety lamp ;
(3) Liquefaction of gases ;
(4) Discovery of many new elements ;
(5) Alloy steels and
(6) Arc lamp.

Today, under the directorship of Sir George Porter, FRS, Nobelman, the main area of investigation is in photophysics and photochemistry with particular reference to the mechanism of biological photosynthesis. The Laboratory's investigation of very fast chemical reactions is internationally known and has improved the time resolution of flash techniques by a factor of million over what was possible a decade or two ago. Much research effort is now going into photochemical methods of storing solar energy and the Institution played a major role in founding The United Kingdom Section of the International Solar Energy Society.

The next important function and the most attractive feature of the Institution became the Friday Evening Discourses, with clear experimental demonstrations, by the resident Director and Professors of the Institution as well as by the outside scientists of repute for the diffusion of scientific knowledge among the public. Normally, these Discourses are held for the members of the Institution while each member was allowed to issue two visitors' cards for admission to the Discourses. Previously, admission to these lectures was free but today visitors and guests are charged differentially.

Next in importance is the annual series of Christmas Lectures, with demonstrations, for the juvenile audience. These lectures on popular scientific topics consist of, normally, a series of six lectures during the Christmas holidays. Faraday himself gave nineteen Christmas Lectures, the first one on 'Chemistry' in 1827 and the last one on 'The Chemical History of a Candle' in 1860. Even today the topics and the lectures are equally attractive. It is like a festival of science during the Christmas holidays each year. The writer, first as a visitor and then as a Member, had the opportunity of listening to both the Friday Evening Discourses and the Christmas Lectures during 1954 and 1972 in London. During the one hour long fascinating demonstration lectures every member of the audience remains spellbound.

In the early years Davy in his meteoric career had marked out the lines on which the Royal Institution was to develop. Faraday maintained and extended the traditions which his predecessor had established. Faraday's successors over the last century and nearly a quarter have not only maintained the same reputable traditions but have also extended further the activities of the Institution according to the needs of the day.

Before coming to the present-day activities it would be worthwhile to mention some of the great names who realized the dreams of the founder Count Rumford.

Early in 1801 Rumford, with the concurrence of the Managers, engaged as lecturer in Chemistry a certain young Cornishman Humphrey Davy, an apothecary's assistant, already known for his discovery of the anaesthetic properties of nitrous oxide, laughing gas. The minutes of the Managers record their decision on February 16 "that Mr. Humphrey Davy be engaged in the service of the Royal Institution in the capacities of Assistant Lecturer in Chemistry, Director of the Laboratory and Assistant Editor of the Journals of the Institution ; and that he be allowed to occupy a room in the house, and furnished with coals and candles ; and that he be paid a salary of one hundred guineas per annum". Later on Sir Humphrey Davy became one of the first in the line of famous Resident Professors who have guided the destinies of this great Institution.

Soon after the advent of Davy the next

famous name was Dr. Thomas Young, the newly appointed Professor of Natural Philosophy. Thomas Young became famous for his researches on the interference of light. His work was later extended by the French physicist Fresnel. Since then Young's reputation had steadily grown, and Young-Fresnel are jointly known internationally for their wave theory of light.

While Thomas Young worked for a short period of two years only Davy spent long years upto 1823 at the Institution. During this period Davy became world famous for the invention of Miners' Safety Lamp and his researches in electro-chemistry. His devotion to experimental work and his powers as a lecturer established Davy as a great scientist and as an expositor of scientific researches in layman's language with experimental illustrations. Since the days of Davy scientific researches and exposition became and have remained, the twin purposes of the existence of the Royal Institution.

The Institution's reputation was further enhanced since Sir Humphrey Davy appointed young Michael Faraday as his 'assistant' in 1813. His long training as assistant, first to Davy and afterwards to Prof. Brande, gave Faraday a wide knowledge of experimental chemistry and a remarkable degree of skill in handling the simple apparatus of the day. Through his continuous brilliant researches in chemistry and electricity Faraday became the first Fullerian Professor of Chemistry in 1833 and continued upto his retirement in 1867. During his long career Faraday established himself as a great scientist through his continuous discoveries in the field of chemistry and electro-magnetism. His discovery of the machine (dynamo) for electric power generation in 1831 made a great impact on the industrial revolution in Britain and also throughout the world. In 1931 Faraday Celebrations to do honour to the memory of the great man and his discovery attracted a remarkable international gathering of scientists and engineers in the lecture theatre of the Institution. During the same period, as mentioned earlier, Faraday made the Institution attractive and unique in character through his fascinating Friday Evening Discourses and Christmas Lectures.

Among the Professors of Natural Philosophy the successors of Dr. Thomas Young who made the Institution famous were John Tyndall (1853-1887), The Lord Rayleigh (1887-1905), Sir J. J. Thomson (1905-1920), The Lord Rutherford (1921-1937) and Sir Lawrence Bragg (1938-1953), who later on became the Fullerian Professor of Chemistry and Director of the Institution.

Since the retirement of Michael Faraday as Fullerian Professor of Chemistry and Director of the Institution in 1867 he was followed by the great men of science :

William Odling (1868-1873), John Hall Gladstone (1874-1877), Sir James Dewar (1877-1923); Sir William Bragg (1923-1942), Sir Henry Dale (1942-1946), Eric K. Rideal (1946-1949); Edward N. daC. Andrade (1950-1952), Sir Lawrence Bragg (1953-1966) and the present Director Sir George Porter (1966-).

As the writer had the pleasant opportunity of visiting the Royal Institution since March 1954 till October 1972 during the days of the late Sir Lawrence Bragg and Sir George Porter he had, besides listening to their marvellous demonstration lectures, witnessed the developments in the activities of the Institution during this period. Sir Lawrence Bragg introduced two important series of lectures viz., Schools Lectures since 1954, still continuing, and the Lectures for Civil Servants to educate the top civil servants in the potentialities and the applications of science—now not regularly held. His first series of Schools Lectures on "Some Famous Scientists at the Royal Institution" with demonstrations of their classical experiments attracted school children from all over the country and continued, like a film show, for more than a year or so. Among other things Sir George Porter has added the Photochemistry Discussion Group, Young Members' Group and Other Lectures like Mountbatten Lecture etc. Today the whole range of activities may be catalogued as follows:

Friday Evening Discourses
Christmas Lectures
Schools Lectures
Library Discussion Group
History of Science Discussion Group
Photochemistry Discussion Group
Group Visits
Young Members' Group and
Other Lectures.

While the Friday Evening Discourses and Christmas Lectures still remain the main features of the Institution, covering topics in all branches of science and technology, it is interesting to note that the lecturers for the above two series, though not paid any fee, feel honoured to be invited to deliver these lectures. Among the Indian scientists the late Sir J. C. Bose had the honour of delivering three Friday Evening Discourses during 1897 and 1903 on the results of his researches in electromagnetic waves and plant responses. In recent year, Prof. M. G. K. Menon delivered a memorial lecture on the late Dr. Homi J. Bhaba.

It may be mentioned here that all the above-mentioned research and academic activities are carried out today by the Professors (including the Director), and Readers supported by a number of devoted research workers, experimental officers, technicians, laboratory assistants and one workshop superintendent on the technical side. The current list includes seven Professors—one each in Astronomy, Chemistry, Experimental Medicine, Natural Philosophy, Physics and Physiology.

The Royal Institution has also been unique for its successful management in another aspect. Since its birth in 1799 the Institution has remained a solely private institution without any State grant. Membership subscriptions, private donations and endowments, and industrial grants are the sources of income. In this respect, our learned societies in India have enough to learn from the Managers of the Royal Institution. The Institution has been patronized by the Royal family since its inception in 1799—the present Patron is Her Majesty Queen Elizabeth II.

The Officers of the Institution include the President, the Treasurer one Secretary, fourteen Managers (of whom five are Vice-Presidents) and fourteen Visitors or the purpose of inspecting and examining the Institution, and the receipts and payments thereof and reporting thereon.

While it is known that our late Sir J. C. Bose founded the Bose Institute in 1917 on the model of the Royal Institution but, unfortunately, it has miserably failed to follow the pattern of Friday Evening Discourses for the diffusion of scientific knowledge through experimental demonstrations among the public.

Now that the Birla Industrial and Technological Museum is celebrating its Silver Jubilee during 1983-84 it is suggested that the same Museum—the first of its kind in India—may consider introducing at least an annual series of popular demonstration lectures similar to Christmas Lectures of the Royal Institution. In executing such programmes perhaps the Museum authorities may form an Advisory Committee drawing members from the organisations like Indian Science News Association, Indian Science Congress and Science Club, Calcutta, which are all engaged in the popularization of science and technology.

While stressing the importance of such popular lectures on science and technology in India it would be appropriate today to mention what Sir George Porter, during his last visit to Calcutta in January 1982, told a press reporter. According to the press report Sir George stressed that anyone who did not understand the spirit of science lead a very incomplete life. Non-scientific attitude harms progress.

Finally, how much devoted have been the successive Directors of the Royal Institution may be guessed from Sir George's plain statement that his domestic life is interesting for a rather special reason. Since he resides in the Royal Institution honoured by names such as Rumford, Humphrey Davy and Faraday he remarked, "I live with a lot of distinguished scientific ghosts". ☐

OBITUARY

G. K. CHAKRAVORTY

Late Prof. Girindra Kumar Chakravorty is no more among the zoologists. He passed away on 23rd May at the age of 81, leaving behind his only son and four daughters and many friends and admirers. His wife predeceased him. He obtained his both B. Sc. and M. Sc. degrees from the University of Calcutta and he stood first in the final M.Sc. examination (1928) and subsequently joined the University as a Lecturer in Zoology. He served this University in many capacities with distinction and honour. Those of us who received lessons in both basic zoology and helminthology from Girindra Kumar know how thorough he was in teaching and research. His grasp of the subject was clearly manifested in his editorial exercises for the Proceedings of the Zoological Society of Bengal for a longer period of the Society's history. It is needless to say that the Proceedings received wide appreciation throughout India and abroad because of his untiring efforts and meticulous skill.

As a man Girindra Kumar was humble, dignified and won both love and admiration from his students, colleagues and non-teaching employees. No administrative or academic problem was an issue to him. He could solve those quite easily without hurting anybody's feelings and sentiments. On retirement from the services of the University of Calcutta he joined the Dantan College, Midnapore, as an administrator.

Girindra Kumar will be remembered by the future zoologists for his notable contributions in the field of systematic helminthology for which he never clamoured for fund or equipments. He had an excellent record of highly productive years during 1936-48 when he was engaged on the characterization of helminths from the common fishes, birds and mammals. He had an unusually rare virtue in his sincerity, persistence and search for classical beauty in natural events. ☐

S. G. Pal

NOTES & NEWS

Peaceful uses of Nuclear Energy

Programme of Department of Atomic Energy of India (1983-84)

Nuclear Power Programme :

As a result of consistent efforts towards self-reliance India is today one of the few countries in the world, and the only one among the developing countries, to attain self-reliance in all aspects of nuclear power generation, starting from prospecting and mining of uranium to fuel reprocessing and waste management as well as plutonium recycle. As the only viable alternative, in the foreseeable future, to fossil fuel based power, a target of 10,000 MW for establishing the nuclear power generation capacity by the year 2000 has been set, constituting about 10 per cent of total power generation capacity in the country at that time. The necessary capabilities to attain this target have been built by the Department with the cooperation of industry. Indigenous design of 235 MWe pressurised heavy water reactors (PHWRs) has been standardised and these, along with indigenous 500 MWe PHWRs a little later, will provide the backbone of the programme. Necessary inputs such as uranium and heavy water will also be made available within the country.

The nuclear power generation capacity increased to 1095 MWe with Unit 1 of MAPP beginning commercial operation on January 27, 1984. During 1983-84 the revenue earnings of Government from the sale of electricity from the nuclear power reactors amounted to Rs. 116.90 crores.

Tarapur Atomic Power Station :

TAPS completed 14 years of operation and achieved a cumulative capacity factor of over 50 per cent. The Station generated 1554 million units of power upto the end of 1983, supplying 720 million units of Maharashtra and 706 million units to Gujarat. The first consignment of enriched uranium from France was received in May 1983. Concerted efforts are being made to indigenously manufacture and procure spare parts for the plant from alternative suppliers.

Rajasthan Atomic Power Station :

After generating 5872 million units of power since, it began commercial operation, Unit 1 of RAPS was shut down in March 1982 due to cooling water (light water) leakage from its south end shield. Considerable original work in problem identification was carried out to determine the nature and extent of the defect and related solutions and investigations are being continued to solved the problem.

Unit 11 of RAPS maintained its reliable performance operating at about 185 MWe and generating 863 million units of power until December 1983, thus meeting 18 per cent of the total power consumption of Rajasthan State. The Unit also supplied steam equivalent to 10 MWe power generation to the Heavy Water Plant, Kota.

Madras Atomic Power Project :

Unit 1 of MAPP attained criticality on July 2, 1983 and was synchronised to the grid on July 23, 1983. The unit has performed very well and began commercial operation from January 27, 1984 steadily generating over 200 MWe. Unit 11 of MAPP is nearing completion and is expected to become operational early in 1985.

Narora Atomic Power Project :

Reactor and turbine buildings for Unit 1 have been completed while those for Unit 11 are nearing completion. Construction of various facilities and installation of equipment and piping is progressing. The units are scheduled to be completed in 1987-88 and 1988-89 respectively.

Kakrapar Atomic Power Project :

Work on the site infrastructure and procurement and fabrication of critical components is in progress. The two units are expected to be commissioned in 1991 and 1992 respectively.

Heavy Water Programme :

Considerable progress was made during the year towards attaining self-sufficiency in heavy water which is the moderator and coolant for the Pressurised Heavy Water Reactors (PHWRs). The heavy water plants at Baroda and Tuticorin have been operating continuously for the last five months. Most of the earlier teething problems encountered in the heavy water programme have been overcome. The heavy water plant at Kota is expected to complete its commissioning trials by the end of October 1984. Work on new heavy water plants at Thal-Vaishet of 110 tonnes per year effective capacity, based on monothermal ammoniahydrogen exchange process and at Manuguru of 185 tonnes per year effective capacity based on hydrogen-sulphide water exchange process proceeded according to schedule. The commissioning activities of the Heavy Water Plant at Talcher were however delayed mainly due to power cuts, erratic supplies of ammonia gas from fertilizer plants and some technical problems.

Attempts are being made to make ammonia based plants independent of the fertilizer plants. A pilot plant set up at Baroda will be trying a new process in this regard. Testing and commissioning trails of this plant are nearing completion.

Heavy Water Upgrading :

Heavy water upgrading plants have been designed and engineered by BARC. The first heavy water and vacuum distillation plant was commissioned satisfactorily at RAPS in September 1982 and from the very first month it exceeded design capacity. The electrolysis based heavy water upgrading plant has been operating satisfactorily at MAPP since March 1981. Work on the design and setting up of new upgrading plants is progressing.

Nuclear Fuel Complex :

The Nuclear Fuel Complex (NFC) at Hyderabad continued to manufacture, fuel and zircaloy structural materials for nuclear power reactors.

The value of production achieved for the fuels and Tubes Groups of NFC till December 1983 was of the order of Rs. 18.62 crores.

NFC expansion phase I, aimed at doubling the out put, has also been taken up.

Atomic Minerals Division :

The Atomic Minerals Division (AMD) continued its integrated surveys and exploration for appraisal and building up of uranium and other nuclear raw material resources. During the year the input in exploratory drilling was considerably augmented and fresh radioactivity anomalies were identified in parts of Karnataka, Madhya Pradesh, Meghalaya, Himachal Pradesh, Uttar Pradesh, Rajasthan as well as additional uranium reserves in the Singbhum Thrust Belt of Bihar. As a result, total indicated and inferred reserves of about 73,000 tonnes of U_3O_8 have been established in different parts of the country.

Indian Rare Earths Limited :

Registered in 1950, with an authorised capital of Rs. 1 crore, Indian Rare Earths Limited (IRE) has been operating a plant at Alwaye, Kerala to process monazite from beach sands, two minor sand separator plants at Manavalakuruchi, in Tamil Nadu and Chavara, in Kerala and a Thorium Plant at Trombay, IRE is also setting up at Chhatrapur, Orissa, the Sands, Complex (OSCOM). The Company is a major exporter of rare earths and minerals.

During the year 1982-83, IREs sales turnover was Rs. 16.47 crores, registering an increase of 21.5 per cent. IRE made a net profit of Rs. 1.39 crores, an increase of 34 per cent over the previous year. The company has been paying dividends to the Government for the last two decades.

Uranium Corporation of India Ltd. :

Registered in 1967, with an authorised capital of Rs. 15 crores, the Uranium Corporation of India Ltd, undertakes mining and milling of uranium ores on magnetite and copper concentrates as by-products. UCIL also produces sulphuric acid mostly for its own consumption.

Under UCIL expansion programme, the plant at Rakha for uranium recovery from copper tailings was commissioned in February 1983. Project report for setting up another uranium recovery plant at Mosabani has been finalised. The new Bhatin mines project is expected to be completed in about three years. Project reports for Narwapahar and Turamdih projects are under preparation. During 1983-84, the production of uranium concentrate was highest since the commencement of operations in 1968. The overall capacity utilisation in terms of production of uranium concentrate was 97.7 per cent and the quantum of ore mined and processed was higher than the previous year.

UCIL earned profit during 1982-83 and contributed to the exchequer Rs. 57.47 lakhs by way of duties etc.

Electronics Corporation of India Ltd. :

The Electronics Corporation of India Ltd. (ECIL) was incorporated in 1967 with an authorised capital of Rs. 10 crores to take up commercial production of Nuclear electronic instruments, components and equipment developed by BARC and TIFR. Later the Corporation diversified its production and established itself in various fields such as communication, instrumentation, nuclear and consumer electronics.

ECIL maintained steady progress during 1983-84 in major thrust areas. The production of the most powerful Indian built computer system-332 has been stabilized.

During the year 1982-83 ECIL's production was Rs. 60.47 crores and net profit of Rs. 2.13 crores was earned.

Nuclear Safety :

During 1983-84 the Department's plants continued their good safety record. The safety status of the plants remained under continuous review by the Safety Review Committee. An Atomic Energy Regulatory Board was established during the year to carry out certain regulatory and safety functions envisaged in the Atomic energy Act.

International Relations :

India was once again designated to the IAEA Board of Governors as one of the globally most advanced states in the technology of atomic energy including the production of source materials. India continued to cooperate with other countries, particularly developing countries, in peaceful uses of atomic energy. □

Nuclear India

New material for utilising solar energy

A new material which absorbs the sun's energy and transmits it with a greater degree of efficiency than has been known till recently has been developed at the Hebrew University of Jerusalem, Israel.

The material, a combination of plastic and glass components, uses 30% of the solar energy which it absorbs. The nature of the new material is such that it can concentrate a large quantity of light on a small area and, therefore, would require only a small amount of solar cells in order to turn solar energy into electricity. By connecting solar cells to surfaces of the material, solar energy can be converted into electricity for home or industrial utility. At the same time, it is also possible to attach optical fibres to the material and thus employ solar energy for operating telephones and computers.

The cost of electricity derived from this material will be 10-30 times cheaper than solar energy now obtainable from solar cells and will be equivalent to the cost of conventionally-generated electricity. It is already worthwhile to enclose roofs and terraces with this new material instead of glass. The material will be most efficient in multistory structures, especially office buildings with a large number of communication lines and computer systems. □

News from Israel

Biology and propagation of *Gelidiella acerosa*

At the Central Salt & Marine Chemicals Research Institute's Marine Algal Research Station, Mandapam, the growth of *Gelidiella acerosa* in two different ecological habitats in the Mandapam region and certain external factors controlling the agar production were studied.

The researcher P. V. Subba Rao observed a conspicuous peak in vegetative growth for the alga following summer months. The alga propagates itself vegetatively, although tetrasporic plants are fairly common. Two growth forms of the alga existed in the Mandapam area, corresponding to the open shore at Ervadi and lagoon at Rameswaram ; this was supported by reverse transplants. Compared to the Rameswaram plants, the Ervadi population was distinctly more productive in respect of bushiness, percentage cover, growth rate, population biomass and half-yearly life-cycles. However, the agar traits did not show significant differences. The maximum agar production was delayed after the peak period of vegetative growth in the lagoon habitat and was concurrent with the growth peak in the open shore.

Based on the chromosomal number, the Ervadi population was classified under separate cytotype. The open-shore form appeared to be evolved as an adaptation to the environment, exhibiting phenotype differences in the number and advanced type of branch systems. Pre-treatments with growth regulators enhanced algal growth in field-cultivation experiments. The effective type and concentration of growth regulators were ascertained.

The study of the regrowth of differentially harvested populations at bimonthly intervals indicated the existence of a short recovery period under moderate harvest. A harvesting schedule for the alga was drawn based on these observations. ☐

CSIR News

Hope for Leukaemia sufferers

Australian scientists have made an important development in genetic engineering which offers new hope for the understanding and treatment of leukaemia.

Two research teams from the John Curtin School of Medical Research at the Australian National University, Canberra, have successfully cloned the gene vital for the reproduction of blood cells. They have isolated the gene in mouse cells and are optimistic that they can now isolate the corresponding gene in humans. The cloning of the gene, called interleukin-3, also marks the beginning of a new area in research on the factors which regulate the formation of the different blood cells from stem cells in bone marrow.

Leukaemia, once an incurable cancer, is characterised by an uncontrolled proliferation of white blood cells. Patients with severe leukaemia can be treated with cytoloxic drugs. These kill both the leukaemic cells and normal bone marrow cells from which they are derived. This often results in the need for bone-marrow transplantation. In the short-term, the isolation of human interleukin-3 would be valuable in speeding up the recovery of patients with bone-marrow transplants. In the longer term, the discovery offered for the first time a "handle on the mechanism" by which white blood cells proliferate.

Transplant patients now are left for a long period without adequate white blood cells to ward off infection. It might be possible that some people suffering from leukaemia could have their own healthy bone-marrow cells grown in the laboratory and injected back to replace diseased marrow. ☐

Australian Information Service

Satellites helps to eradicate disease

Mustering cattle with satellites helps Australian agricultural experts pinpoint areas of the country hiding undetected cattle.

Landsat IV satellite imagery is one of the latest tools contributing to continent's national survey of its cattle in a campaign in eradicate bovine tuberculosis and brucellosis. Australia hopes to get rid of both diseases by 1993. One or other of these diseases now infects 10% of nation's herds, placing about 3.6 million cattle at risk of contamination.

The difficulty of mustering cattle for herd testing is the biggest obstacle facing the eradication program in northern Australia.

Using Landsat, Peter Laut of CSIRO, has developed a method to estimate how much of the northern cattle country fits into specially defined categories of mustering difficulty. He examined the range of landscape types and their extent and approximate distribution so that the Bureau of Animal Health could accurately estimate the costs involved in a clean muster. His study area extended to cattle stations in the rugged country in the north and included the Kimberleys of northern part of Western Australia and the tall grasslands of the Nothern Territory inhabited by water buffalo. He used the

1 : 500,000 Landsat images to identify six types of vegetation in the study area. Linking the previously published map data with corresponding Landsat images, he estimated what proportions of each 4 km² and 100 km² cell were easy or difficult to muster, in terms of vegetation and land forms.

The Bureau of Animal Health will use Laut's results to develop a more accurate estimate of the cost of the mustering required to complete the TB eradication programme. In areas where mustering would be too costly search destroy operations, using helicopter-borne marksmen, will probably have to be implemented ☐

Australian Information Service

Absence of sunlight linked with bone fractures

Elderly men and women who spend most of their time indoors, away from sunlight, appear to run a high risk of bone fractures. Vitamin D, which is essential for healthy bones, is produced in the body when the skin is in light.

A team of medical scientists from South Australia reported to an international symposium on bone disease held in Adelaide that evidence existed to suggest that lack of sunlight—the body's main source of Vitamin D—contributed to a high incidence of hip fractures in the 70-80 age group. Vitamin D is needed for bones to take up calcium and Phosphorus—minerals which are essential for bone growth and stability.

The team, from the South Australian Institute of Medical and Veterinary Science and the Royal Adelaide Hospital, after examining "household" patients in a large metropolitan nursing home, said that they had found very low levels of Vitamin D in comparison with another group of the same age who often went outdoors and whose vitamin D levels were normal. Examinations of a third group of patients admitted to hospital with hip fractures revealed that they had very low levels of the vitamin.

The scientists remarked that they intended to investigate the possibility of recommending to public-health authorities that they regularly expose elderly people to sunlight or give them vitamin D supplements. ☐

Australian Information Service

V. WATER-SUPPLY AND DRAINAGE

WATER-SUPPLY AND DRAINAGE FOR CALCUTTA

(Key-note Address)

R. B. CHAKRAVARTY

ON the subject matter before this session, the question of population appears to be the most important. This matter would however be deliberated in another session and we need not go into details of it. Water-supply will have a direct bearing on this matter, while storm-drainage will have only marginal effect due to increase in population, unless the area is increased. The sanitary drainage, or the dry weather flow, will increase proportionately with the population but in the combined system of drainage this would not cause any difficulty.

Water-Supply

To appreciate the situation beyond 2000 A. D., it would be necessary to ascertain the present and projected arrangements. It is known that the water-works for Calcutta are located at Palta. River water is pumped into 4 settling tanks (after alum treatment) and the presettled water is taken through a vast sedimentation basin (constructed in 1926), on to the slow sand filter beds. These beds were constructed in stages from 1868 to 1926, (totalling 59 in number) having a gross capacity of 99 MGD, out of which about 15% may not be available due to maintenance works and other difficulties. In 1948 a Rapid Gravity Filter (18 MGD) was installed which is also supplied from the sedimentation basin, taking the useful capacity to 100 MGD. In the 'sixties', a 60-MGD unit of Rapid Gravity Filter was installed with Clarifloculator plants attached. A few of the slow-sand filter beds were dismantled to accommodate the installation of some other clarifloculators for supplementing the supply to the slow-sand filter beds. The net capacity is thus somewhat less than 160 MGD. There is arrangement for chlorination of the filtered water at Palta.

The filtered water is then pumped to Tala ground reservoirs through four pipes (42″ – CI, 48″ – CI, 60″ – MS and 72″ – MS-cathodically protected), having a total capacity of 176 MGD. (The 60″ pipe is badly corroded and a new cathodically protected 60″ pipe is being installed to replace the old one). There are three ground reservoirs at Tala, each having its own pumping station. The pumps supply water direct into the distribution system during peak hours, while a major part of pumping capacity is utilised to pump the water to the overhead reservoir, which supplements the peak hour needs.

The distribution system consists of Zone-Mains meant for different areas. On account of intermediate tappings (probably not in the original planning), the pressure in distant places (like Kalighat, etc.) is reduced. To overcome this difficulty an underground reservoir has been constructed at Aukland Square for storage during non-peak hours, to be pumped into the Mains during peak hours. Also for the same reason the underground tank at Subodh Mullick Square has also been renovated and fitted with a pumping system.

With the construction of the Barrage at Farakka, it has been practicable to set up new water-works at Garden Reach. This system is to have a total capacity of 60 MGD but is meant for other adjoining areas in addition to Calcutta area. There is some proposal for augmenting the capacity of Palta Works but this is for meeting the needs of the Palta Service District. (Already 10 MGD unit has been commissioned at Garden Reach). If a reasonable quantity of Garden-Reach water is made available for Calcutta, the latter area would have somewhat less than 200 MGD.

In addition to the Filtered Water supply, Calcutta has also an unfiltered water arrangement from two pumping stations on the banks of the Hooghly. The water is meant for fire-hydrants and flushing of the latrines in North Calcutta. Silting and corrosion damages have affected the working of this system and there was a proposal to abandon the system. In such a case there would be increase in the demand for filtered water.

While the seminar speakers would discuss on the needs of the projected population, and examine as to whether the arrangement expected by 2000 A. D. would meet the needs, they may also consider the following important points :

(1) The maintenance of slow-sand filter beds is a rather delicate process. The useful life and efficiency of the sand-bed depends upon proper maintenance of the schmutzdecke formed at the top of the sand-bed. This layer arrests practically all the fine silt and allows only the clear water to pass through the sand-bed. However this layer cannot withstand high differential head, which is specified as 4 inches. This is achieved best by using automatic controls I have seen a few of these equipments in the stores at Palta, but it did not appear to me that any of these had ever been used. The control is exercised by manual control of delivery valves left to the field workers, who may not have proper appreciation of the limitation of head, when they are required to arrange for increased supply. As a result the schmutzdecke might be damaged allowing fine silt to pass through the sand-bed below. Once the sand-beds are choked, by such operation over the months, the filter bed would work inefficiently. May be due to this, the capacity is usually lower than estimated.

(2) The speakers would have to deliberate on the per capita per day requirements of filtered water taking into consideration that the unfiltered water supply may not be available. Also increasing standards of living are to be considered. In arriving at this they are to consider the wastage and misuse of water in houses and on the streets, unless some positive ideas can be worked out to take care of the same.

(3) They are to consider the requirements for the new urban areas growing up officially and unofficially in areas adjoining the city, from where there would be demand for water. They are also to consider addition of commuters to the city.

(4) If the Salt Lake city is to be supplied from Tala, the possible requirements are to be considered.

(5) No doubt some of the multistoried buildings coming up are providing for their own deep tube-wells, but high draw-down from such uncontrolled arrangements is likely to lower the ground-water table to make it unpracticable for the usually available pumps, as happened in California in the fifties.

(6) Consideration is to be made for projections after 2000 A. D.

Drainage

The City has been located on the bank areas of the Hooghly, where it has a natural slope from west to east. Originally the drainage was led into the adjoining Bidyadhari channel. After its deterioration, the new out-fall system was built up leading the drainage to the Kulti river.

Calcutta area from Bagbazar to Ballygunge (including Alipore and New Alipore) is served by the combined (Storm drainage and sanitary drainage) system. The drainages are collected from houses and gully-pits and taken to the Palmer Bazar and Ballygunge pumping stations through underground sewers. During the monsoon months the combined drainage is pumped into the storm water outfall channel and discharged into the Kulti through sluices. During the non-monsoon months, the dry weather flow

(DWF) is taken to Bantala for primary treatment from where the effluent is taken and discharged into the Kulti, through the DWF channel.

After taking over the outfall system, the I & W Department resectioned the storm water channel to the maximum section practicable within the land width acquired. This has been found to accommodate the drainage of Calcutta (excluding Manicktala block) including Tollygunge-Kasba area, which drains through the Panchannagram canal and pumped into the outfall channel at Chowbhaga. The Kristopur canal has been converted into a drainage channel to take the drainage from Manicktala block and from Salt-Lake city, Lake Town, etc. The Manicktala Block has combined systems in Ultadanga and Beliaghata areas, but the central lower part has separate system of drainage. The Salt Lake city has a separate system with its sanitary drainage treated in a treatment plant. The storm water is drained into the Kristopur Canal.

The drainage from Manicktala block is to pass through Kristopur canal; the drainage from Ultadanga and Beliaghata areas are initially taken through the Circular canal by gravity flow. The Bagjola canal takes in the drainage from Cossipur and adjoining areas. Local areas near Topsia, Pagladanga and Kulia-Tangra are drained into the outfall channel through respective pumping stations. There are two important intermediate pumping stations at Raja Dinendra Street and at Mominpur for boosting up the drainage, but there is operational difficulty, when the sewer downstream is already running full during heavy rains.

In the combined system area the runoff provided in the sewers are one-fourth inch per hour for north Calcutta and one-sixth inch per hour for the south Calcutta. These are too small provisions in comparison to the estimated runoff based upon rainfall and time of concentration, even assuming that there would be inundation on the streets once in two months. The difference is quite appreciable in respect of smaller sewer pipes, because the time of concentration in such cases are small and concentrated flow is higher. As a result there is frequent inundation in the combined system area. To overcome this difficulty overflow sewer pipes are being laid wherever practicable to bring relief to the combined service sewers. The newly designed separate system conduits are generally based upon the two-months' frequency of inundation. The over-flow conduits are to drain into the Tolly's Nullah and Circular canal generally by gravity flow.

Apart from the inadequate provision in the combined system sewers, the scanty flow during the non-monsoon months laden with high proportion of solids, deposits the silt in the sewers, which cannot be fully cleared during the monsoon flow, particularly near the pumping stations. The normal practice is to make attempts to clean the sewers by manual labour, which is extremely difficult in most cases. Lately mechanical appliances are being used, but in some cases these are causing damage to and even collapse of the sewers.

On the subject of storm-water drainage, the seminar speakers may consider discussing the gradual extensions of the city on the eastern side, which in any case would have to be drained through the three outfall channels mentioned above, until new channels are excavated. The result will be that the frequency of overflooding of the outfall channels would be increased.

As regards sanitary drainage, it may be said that the DWF from the combined system areas is only primarily treated and hence it pollutes the Kulti river. For the Salt Lake area there is proper treatment plant. For Manicktala area the combined drainage is taken through Kristopur canal and thus pollutes the Kulti. The central low area of Manicktala block may be provided with a treatment plant. For the Tollygunge-Kasba area the proposal is to have an exidation pond immediately which would be replaced by proper treatment plant in due course.

Although lands have been acquired for the treatment areas, nothing else has been done. In the meantime the area has been crowded on the fringes of Tolly's Nullah and the sanitary effluents are discharged into the storm drains draining into the Tolly's Nullah causing hazard to the bathers in the Nullah (Adi-Ganga). □

CALCUTTA'S WATER-SUPPLY AND DRAINAGE

SISIR KUMAR NEOGI

Municipal Engineering Directorate, Govt. of West Bengal, Calcutta

THE Master Plan for Water-Supply, Sewerage and Drainage for Greater Calcutta was prepared by Calcutta Metropolitan Planning Organisation (CMPO) in 1965 and that in collaboration with W. H. O., CMWSA and CMDA were constituted for execution and maintenance of the projects identified by CMPO in their Master Plan. During execution both CMWSA and CMDA felt the necessity of some modification of the earlier proposals/plans of CMPO and they also felt that CMPO's Master Plan for Water-Supply, Sewerage and Drainage should be up dated. CMDA was created in 1970.

Water-Supply

Northern portion of CMD (Calcutta Metropolitan District) was proposed to be fed from underground water. The Southern CMD due to bad quality of underground water and poor reservoirs is to depend on treated water from the river Hooghly. Salinity and pollution factors are making the water treatment process and plans costly. The existing congestions of the roads due to traffic and underground services make the execution of the programme hazardous.

CMPO could not anticipate faster growth rate and industrial demand of water of the southern industrial zones like Haldia, Falta, Kolaghat, etc., on Calcutta's system. The price escalation baffled all estimations. The cost of treated water became very high. Per capita consumption of water prescribed by CMPO had to be slashed down. Renovation and replacement of the old worn-out pipelines could not wait. The Cathodic protection to the worn out pipe lines and also encasing the pitted waterlines with concrete were not feasible due to very bad condition of the pipe lines.

The geographic look of CMD area started changing thus making the Southern CMD more and more populous and expanding. Water-Supply Districts proposed by CMPO in 1965 had to be redrawn.

With the increase in the cost of production of water and maintenance of the water-supply system the existing water tax both in the Calcutta Corporation area and in other municipal areas proved to be insufficient. CMWSA thought of introduction of water meters to every household. But it would mean additional capital expenditure to the tune of a few crores of rupees and also a huge maintenance. Due to bad quality of underground water (big dia tube-wells) the life of the water meters is bound to be reduced, thus making the entire project costly.

CMDA is supposed to draw up an updated Master Plan to speak about the situation beyond 2000 A.D. The plans that are being prepared by CMDA are mostly short term project plans. I propose that a separate agency should be engaged by CMDA to update the existing master plan (upto 2000 A.D.) and draw up a plan upto 2025.

Sewerage and Drainage

Master Plan of CMPO proposed separation of sewerage (sewage carrying pipeline) from drainage (rain water carrying pipelines). Due to paucity of funds and also narrowness of the roads and traffic congestion the work could not be proceeded fast. Moreover, newer township areas around Calcutta drew more attention than the old Calcutta areas. At the same time the main-outfall system of the Calcutta City failed miserably as the Planning Commission but less stress on the drainage of the rural areas, through which the Calcutta outfall passes. Though there was a great promise that southern West Bengal specially the Sunderban Areas would get sufficient funds to develop the estuarine areas of the Gangetic Delta, in actual practice nothing big came out. Similar is the situation with the Western CMD. Unless there is any assurance of a big outlay to develop the drainage of the suburbs of Calcutta, mere improvement of the interval system won't help much.

Pumping of sewerage or rain water can be a temporary solution for a short period. It increases the cost of pipelines and also the cost of maintenance. In any situation, improvement of sewerage and drainage facilities and its maintenance is a huge burden on the local bodies. Even if CMWSA maintains it, they must have sufficient authority to realize additional taxes from the beneficiaries so that the system can be maintained efficiently.

Besides the permanent residents a few lakhs of floating people come to CMD for their business and livelihood. These people should pay for the civic facilities that they enjoy during the few hours they spend in CMD.

CMPO's Master Plan did not work in details about the treatment and disposal of the waste waters. We should put all our efforts to complete the works we started (e.g. Howrah) and also draw up detailed plans for all other areas including Northern CMD.

Shri Subrata Sinha, the noted geologist is against expansion of the southern CMD for planned township. In his opinion the water logged southern CMD is bad in all respects. It is better that satellite townships should be developed in Northern and North-Western CMD area, if necessary by revising the geographical boundary of CMD. This is a very serious proposition. CMDA should engage a band of expert engineers and scientists to crystallize the stray thoughts put forward by the eminent thinkers.

Nothing can be predicted about Calcutta beyond 2000 A.D. before we prepare an updated Master Plan. CMPO prepared the Master Plan in 1965. CMD started work in 1970. Let us prepare the revised Master Plan and complete it by 1990 and then project the CMD beyond 2000 A.D. □

SEMINAR ON CALCUTTA BEYOND 2000 A.D.

VI. EDUCATION

EDUCATION BEYOND 2000 YEARS

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CALCUTTA with parts of the districts of 24 Parganas, Howrah and Hooghly (and a small area of Nadia) from the Calcutta urban agglomeration. The growth rate of Calcutta city for the decade 1971-81 is 4.54% only. Thus from 1951-61 onwards this city has been experiencing a clearly discernible decreasing rate of growth. From 8.4% in

1951-61, it fell to 7.57% in 1961-71 and has now marked a further fall which is relatively sharp in nature. From this trend it may be held out tentatively that the popular belief that the Calcutta city is demographically drawing closer and closer to a saturation point, is perhaps correct. On the other hand, the growth rate of the urban agglomeration of Calcutta tends to lend credence to another popular belief that the urban agglomeration is very much alive and still a drawer of crowds. How much of the growth of the urban agglomeration however is due to out-migration from the Calcutta City and immigration from beyond the urban agglomeration itself is difficult to judge without complete set of migration tables.

The urban agglomeration of Calcutta 1971 and that of 1981 are not the same area geographically, the latter being larger than the former. This time the urban agglomeration of Calcutta covers apart from Calcutta Municipal Corporation itself (which is coterminus with Calcutta district) 3 units in Nadia, 76 units in 24 Parganas, 38 units in Howrah and 26 units of Hooghly district. The total population of the urban agglomeration in 1981 has come to 91,65,650 against the 1971 figure of 70,31,382 thus registering a 30.35% increase. The population of Calcutta District in 1981 has come to 32,91,655 registering a decennial growth rate of 4.54.

If we consider literacy we find that the percentage of literates to total population has gone up in West Bengal from 33.20% in 1971 to 40.88% in 1981 thereby registering an increase of 7.68%. In Calcutta urban agglomeration the overall percentage of literacy rates is 65.24% in 1981 ; 70.67% for males and 58.31 for females. In Calcutta Municipal Corporation the overall percentage of literacy rate in 1981 is 68.99 i.e. 3.75 p.c. higher than the previous rate. The literacy rates for males and females are 73.21% and 63.07 respectively.

In the directive principles of state policy of the constitution of India under section 45 it is stated :

The state shall endeavour to provide, within a period of ten years from the commencement of this constitution, for free and compulsory education for all children until they complete the age of fourteen years. Let us examine the position of primary education at the national level. The total population of India is 68.40 crores in 1981. The projected population in the age groups 6-11 years and 11-14 years has also been estimated as 8.79 crores and 5.01 crores i e. a total of 13.80 crores in 1981-82 in the age group (6-14) years. The total enrolment in school classes I-VIII is 9.46 crores in 1981-82. Therefore for the age group (6-14) years 4.34 crores of children are not attending any school. Percentage of enrolment to their respective age group of population is given below.

TABLE 1 : Enrolment Ratios (as percentage)

	1981-82		
Classes/Age group	Boys	Girls	Total
I—V (6-11 years)	99.4	66.9	83.7
VI—VIII (11-14 years)	54.2	29.1	41.9

In Calcutta Municipal area the number of children in the age group 6-14 years is about 6.58 lakhs in 1981 ; enrolment ratios for boys in (6-11) age group is almost hundred per cent but for girls in the same age group, it is low. For the next age group i.e. (11-14) years the overall enrolment ratio is 70%.

If we consider the percentage of functional literates and not the percentage of literates only then we find that the situation is worse. The overall figure of wastage and stagnation determined for the country as a whole by cohort method with 1971-72 as the base year reveals that for every 100 children enrolled in class I only 37.02 stayed in class V and for boys and girls these figures are 39.29% and 33.82 respectively. This clearly shows that the enrolment ratios are not adequate indices for functional literacy because the drop out rate at the end of class I is almost 50%. Before independence the enrolment ratio was very low even for class I. Reasons for low enrolment were given as (i) meagre investment in education and (ii) inadequate number of primary schools in each region. After independence the National Government set up almost one school in each village ; the number of primary and middle schools being more than 5 lakhs, and in addition it also provided about 22 lakhs of teachers with improved salary scales. But unfortunately the things have not improved to the desired extent. This is a serious concern for the government.

In the city of Calcutta there are about 1000 primary schools and in addition 270 primary schools under the corporation of Calcutta. The number of students reading in corporation schools is about 55,000 remaining children are reading in primary schools run by the Government. All categories of schools in Calcutta are not only free, but they also supply books to the students. The number of children in the age group (6-11) is about 4.11 lakhs in Calcutta and to arrange schooling for all of their we need about 500 more primary shools in the years beyond 2000 A. D. Even by establishing these schools we are not sure whether we would be able to improve the percentage of functional literacy in the city because the drop out rate is very high. We have to seek other types of education which will be different from regular schooling because (a) cost will be prohibitive progressively and (b) large percentages of drop outs will continue.

Interest in nonformal education in recent years, is getting a growing recognition and it has been released that education can no longer be viewed as a time bound and place bound process. In contrast to the view that equates education with schooling and measures it by years of exposure, many countries from the out set have adopted a concept of education that equates it broadly with learning, regardless of where when or how learning occurs. In Calcutta beyond 2000 A.D. we have to accept this broader view about education and we should not depend only on schooling.

Education thus defined embraces more than the conventional academic skills and subject matter. It includes for example the acquisition of occupational, household skills, the development of aesthetic appreciation and analytical modes of thinking the formation of attitudes, values and aspirations, the assemelation of pertinent knowledge and information of many sorts. These different kinds of learning to be sure, vary greatly in their depth and complexity, in the time, effort and maturity required to attain them. We should recognise that education by its very nature is a continuing process starting from earliest infancy through adulthood, that necessarily entails a variety of methods and sources of learning. We have found it useful to group these learning methods into the following categories recognising that there is one overlap and a high degree of interaction between them (1) informal education, (2) formal education and (3) nonformal education.

By informal education we mean truly life long process whereby every individual acquires attitudes, values, skills and knowledge from daily experience and the educative influences and resources in his or her environment—from family and neighbours, from work and play, from the market place, the library and the mass media.

By formal education we refer of course to the heirarchically structured, chronologically graded educational system running from primary school through the university and including in addition to general academic studies, a variety of specialised programmes and institutions for full time technical and professional training.

We define nonformal education as any organized educational activity outside the established formal system—whether operating separately or as an important feature of some broader activity—that is intended to serve identifiable learning clienteles and learning objectives.

Formal and informal education are alike in that both have been organised by societies to augment and improve upon the informal learning process—in other words to promote and facilitate certain valued types of learning that individuals cannot as readily or as quickly acquire through exposure to the environment. They differ mainly in their institutional arrangements and procedures and to a considerable extent in their subject matter and learning clienteles.

To consider the educational requirements of children in any region and to plan provisions for meeting them, one must have a clear and realistic conception of their minimum essential learning needs. The 'minimum package' would doubtless differ from one area to other, yet despite the very diverse needs of different regions, there would probably be agreement among most educational leaders that in more general terms that the package should consist of the following six elements :

(i) *Positive attitudes* towards co-operation with and help to one's family and fellow men, toward work and community and national development, and not least of all toward continued learning and toward the development of ethical values.

(ii) *Functional literacy and numeracy*, sufficient (a) to read with comprehension a national newspaper or magazine, useful agricultural, health and other 'how to do it' bulletins ; (b) to write a legible letter to an agency requesting information etc. ; (c) to handle important and common computation's.

(iii) *A scientific out look and an elementary understanding of the process of nature* in the particular area for example to health and sanitation, to raising crops and animals, to nutritions, food storage and preparation ; environment and its protection.

(iv) *Functional knowledge and skills for raising a family and operating household.*

(v) *Functional knowledge and skills for earning a living*, including not only the skills required for a particular local occupation but also a knowledge of a variety of locally useful common skills for agriculture and nonfarm use.

(vi) *Functional knowledge and skills for civic participation.*

What is clear from this list of minimum learning needs is that no one mode or institution of education—formal, informal or nonformal is capable by itself of meeting all the minimum essential learning needs. The objective cannot be reached by the linear expansion of formal education what is required is to redesign and reform the present programme by innovative and new programmes.

The major weaknesses of the formal system (*both school and university*) may be summarised as follows :

(a) *School System* : State schools cover a very wide range both in pupil numbers as well as the facilities they make available inspite of various regulations on school admission a few large and rich schools continue to grow larger and richer while the small and poor schools become poorer. They have become a more medium for competition than institutions imparting sound all round education. Excessive emphasis on examinations has led to an impoverishment of the content of learning inside the class-room and dimunition of the importance of those most valuable outcomes that accrue from cocurricular activities. In serving primarily the scramble to reach the top, the needs of the majority who cannot get there are neglected. What gets most attention is subject matter that can be tested at national level written examinations. What tends to be neglected are others equally if not more important aspects of curriculum such as content of local relevance and practical subjects. The teaching service is influenced by a number of factors which tend to lower performance levels.

(b) *University System :* The university system too expanded almost to the same extent as the school system in response to the rising demand of the society. Such expansion inspite of inadequate resources and poor planning led to a deterioration of quality. The glaring weaknesses of this system are (i) non-availability of sufficient literature in mother tongue for the large majority of undergraduate students, who are consequently obliged to rely almost wholly on notes and (ii) the failure of universities to live up to their expected roles as communities excelling in learning and research. The present system of formal education and training have many weaknesses which if not overcome would render these sectors more and more disfunctional.

The proposed system of education will consist of two segments, one formal and the other nonformal—both are inbuilt in the system. The formal will include school system and university system and the nonformal will include tertiary education system. Students learn that education is valuable when it is acquired in school through a gradual process of consumption, that the degree of success the individual will enjoy in the society depends on the amount of learning he consumes, and that learning about the world is more valuable than learning from the world. The imposition of this method with an educational programme distinguishes schooling from other forms of planned education.

The span of general education open to all will consist of

(i) 4 years of primary schooling in classes I to IV,

(ii) 4 years of junior secondary schooling classes V to VIII,

(iii) 2 years of secondary schooling classes IX and X.

An examination with certification at the school level will be held at the end of class VIII to enable early school leavers to obtain a certificate. This is the first diversion point at the end of age 14. According to directive principle, all children in this age group should get the facility for formal training in accordance with the six minimum needs stated earlier. School leavers are expected to join Industrial Training Institute and artisan an courses such as carpentry, pottery, blacksmith, mechanics etc. For them education is not closed. Parallel to formal schools, open schools will operate with time constraint relaxed and syllabus modified. From class IV, these open schools will start functioning. The industrial training centres and artisan courses will provide the skill and open schools will provide general knowledge and mathematics. This new proposed adjunct will take care of the large percentage of drop outs which is nearly 70%.

The span of general education will terminate with the school leaving certificate examination held at the end of class X. This will be the second diversion point. Students will join polytechnics, apprenticeship courses, fine arts, photography, paramedical courses. These courses will provide them with necessary skills and at the same they can prosecute further studies in open universities which are free from time and syllabus constraints. The present system proposes to establish a link between work and study at every diversion point i.e. the proposed structure is an open one which is distinct from a closed one.

The last tow classes in the school system will be accessible to only to those with a strong academic aptitude and will prepare students for the university entrance examination. An alternative to the present system would be to hold competitive examination for students who have completed their +2 course. This will be the third diversion point. It might be possible to organise tests by which brighter students with higher promise can be picked up for government jobs. Thereafter they can be given in special institutions a three year degree level course in subjects which will equip them for their duties in public service. The same scheme is capable of adoption by business industry as well.

After this 2 stage, only those students will go to colleges who are genuinely interested in higher studies and who have an academic bent of mind. The present rush for admission to colleges in the vain hope that a degree will lead to a job will disappear. There will be radical change of atmosphere in colleges and universities as serious minded scholars become the main elements in the student population. Selection to universities will be based on the university Entrance examination. Universities will be developed into centres of excellence devoting a good proportion of their resources to postgraduate studies and research.

The open university will enable those in employment and others who cannot devote their full time to studies to pursue higher studies. The open university will concentrate initially on courses needed for meeting the urgent manpower requirements of the country.

Like University Grants Commission a Tertiary Education Commission should be established for the purpose of guiding, coordinating, developing and supporting non-university Higher Education and Technical and Vocational Education. A large number of students on the completion of their general education will be selected for tertiary education courses. These will be catered to primarily by

(1) The professional colleges providing courses for a wide established professions.

(2) The Technical Education authorities providing technical and Vocational education at all levels.

(3) The Agricultural Education Board providing practical Agricultural education and

(4) The open school providing self-enrichment courses as well as courses for re-entry into formal educational system.

All bodies mentioned above fall within the realm of Non-Formal Education.

To day the country is spending a staggering sum of Rs. 3,500 crores on the education of its 100 million students. They are taught by three million teachers spread over 6,50,000 schools and colleges This includes 3 million students in 120 universities. Parents spend another Rs. 8,000 to 10,000 crores to support them. This huge infrastructure has failed to eradicate poverty in the country, on the other hand educated unemployment is mounting. It is expected by combining education with work the situation may change. This objective may be achieved to some extent by introducing integrated system of education. □

QUANTITATIVE APPROACH OTHER THAN NON-TECHNICAL EDUCATION

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As man does not live by bread alone, a metropolis does not live by roads, drains, sewer lines and fly-overs alone. A metropolis contain millions of living people who need some major community facilities which cannot be neglected by a responsible Government. Education is one of such facilities which eradicates illiteracy and ignorance and improves the quality of the working and non-working population. It also helps economic growth and technological progress.

Though for education the CMDA is not directly involved in the planning and execution of programmes, but the aspect of land requirement for Land Use Planning in a Metropolitan Area like the CMD indeed poses a great problem as there is an acute shortage of land for various uses.

In this discourse a brief account for additional educational institutions, land and finance to be required beyond 2000 A.D. (upto 2011) from 1971 has been made. Some hints have also been given to indicate how the required quantum of institutions, land and financial involvement could be minimised.

Existing situation

To talk about the data source, the information were collected from the Census, Education and Town & Country Planning Departments, Government of West Bengal and Anchal Panchayet Offices within the CMD.. The information are of March 1971 within the CMD boundary. The projected population figures have been used from various CMDA Planning papers (Table 1).

TABLE 1 : Institutions as on March 1971

Level of Education	Age Group	P. C. of Total Pop.	P. C. of Student Enrolled	Avg. Student/ Institution	Total Institution
Primary (Class I to V)	6—10	13	69	228	3262
High (Class VI to X)	11—15	11	55	445	1126
Higher Secondary (Class XI to XII)	16—17	3	45	178	628
College (3 years Degree-Course)	18—20	5	26	1150	93

(a) *Primary*: The responsibility for provision of Primary Education rests on the State Government and Local bodies. Children belonging to 6-10 years of age which constitute 13 per cent of the total CMD Population come under this category. At present 69 per cent of the above age-group are enrolled in 3262 primary institutions. The average enrolment per institution is 228 with ranges from 186 to 327.

It requires to emphasize here that the percentage of overall enrolment in the CMD is much below the National and State target of 88 and 80 respectively at the end of the 5th Five Year Plan.

(b) *High*: This contains five classes from Class VI to X. The age-group belonging to this category is 11-15 years. Eleven per cent of the total CMD population are included under this category. At present 55 per cent of the above age-group are enrolled in 1126 High Schools. The average enrolment is 445.

(c) *Higher Secondary*: Classes XI and XII fall under this category. The age-group belonging to this level of education is 16-17 years. This constitutes 3 per cent of the total population. There is no exclusive institution for these two classes. Some High Schools and many Degree Colleges extend facilities for this education. At present in 628 institutions this level of education is taught with an average enrolment of 178 students. The percentage of enrolment is 45.

(d) *Degree College*: In the CMD there are altogether 93 Colleges for general education. The present enrolment is 26 per cent out of 5 per cent of the total CMD population in 18-20 years age-group. The average student strength of an institution is 1150.

Future Requirement

(i) *Quantum*: For the assessment of the future need of various level of educational institutions beyond 2000 A.D. (upto 2011) the targets for students' coverage and average number of student per institution of each category were assumed as follows:

(a) Primary enrolment as hundred per cent.

(b) High, Higher Secondary and College levels remaining at the existing proportion of coverage.

(c) The average enrolment of students at each level of educational institution would be more or less at par with the present size except for Higher Secondary level where the present enrolment pattern appears to be on the lower side. Thus for Primary, High, Higher Secondary and College the enrolment of an institution has been assumed to be 225, 450, 240 and 1200 respectively.

From the above assumed coverage and enrolment capacity it has been calculated, as shown in Table 2, that beyond 2000 A.D. (upto 2011) from 1971 there would be an additional need of 4568 Primary, 1142 High Schools, 262 Higher Secondary Schools and 83 Degree Colleges.

TABLE 2 : Deficit in Educational Institutions beyond 2000 A.D. (upto 2011)

Level of Education (1)	Educational Institution Existing (1971) (2)	Required (2011) (3)	Deficit (Col. 3 – 2) (4)
Primary	3262	7830	4568
High	1126	2268	1142
Higher Secondary	628	890	262
Degree College	93	176	83

(ii) *Land* : The availability of open space in the urban- and rural-residential areas of the CMD is limited and the land values are also very high. So the available vacant land may be utilised cautiously and properly. Possibilities of multiple-use functions shall have to be explored. Thus it is suggested that new educational institutions may be located near the existing and proposed organised open spaces, within the residential area, where the students, particularly of schools, can have an opportunity of sports, games and other out-door activities. Accordingly minimum standards of land area can be considered for Primary, High, Higher Secondary and Degree Colleges as 6, 8, 10 and 50 cottahs respectively. These exclude open space within each educational institution. To avoid possible constraints of land value, availability of open space and locational building byelaws etc. vertical expansion of the institutions may be necessary.

Thus from the above is has been calculated that beyond 2000 A.D. (upto 2011) from 1971 the additional requirement of land for Primary, High, Higher Secondary and Colleges would be 456.8, 128.4, 29.7 and 69.2 acres respectively. The estimates exclude the question of actual availability of open space appurtenant to each new institution in the different areas where it might be located.

(iii) *Finance* : The capital cost implication of the additional institutions can be seen by using plausible norms for land price and construction. The land price varies widely from area to area. The material cost is also changing from time to time. The minimum space required within a class-room to accommodate the stipulated number of students at each level can be guessed by using standards in anthropomorphic measurements for students' sitting arrangement and other ancillary functions of the institution. Accordingly, the cost for building may be taken as rupees 1.5, 4.0, 6.0 and 10.0 lakhs for Primary, High, Higher Secondary and College respectively with average land cost per cottah as rupees 15 thousand.

Thus from the above the total required capital cost, as shown in Table 3, would be rupees 187.6 crores beyond 2000 A.D. (upto 2011) for all levels of education in the CMD. This amount will have to be meaningfully phased over the on-coming 27 years from

TABLE 3 : Capital Cost of Additional Institution beyond 2000 A.D. (upto 2011)

Level of Education	Additional Institution	Land Required (in Acres)	Capital involved (in Rs. Crores) For land @Rs. 15 thousand/Cottah	For Building	Total
Primary	4568	456.8	41.1	68.5	109.6
High	963*	128.4	11.6	38.5	50.1
Higher Secondary	179**	29.7	2.7	10.7	13.4
College	83	69.2	6.2	8.3	14.9
Total	5793	684.1	61.6	126.0	187.6

* 1142·179 = 963 derived by assuming the provision for X Class Education in New High Schools.

** 1262-83 = 79 derived by assuming the provision for Higher Secondary Classes in New Colleges.

to-day (i.e. 1984) averaging an expenditure of about rupees 6.9 crores per annum.

The major burden of expenditure is on Primary and High Schools. If construction of all Primary and High Schools is not feasible at the initial stage, measures can be taken for double shifts in new institutions in these categories. This will also accelerate the improvement of literacy rate. The capital cost on this basis, as shown in Table 4, will be rupees 107.9 crores, averaging rupees 3.9 crores (approximately) per annum.

TABLE 4 : Minimised Capital Cost of Additional Institution beyond 2000 A.D. (upto 2011)

Level of Education	Additional Institution	Land Required (in Acres)	Capital involved (Rs. Crores) For land	For Building	Total
Primary	2284	228.4	20.6	34.3	54.9
High	482	64.3	5.8	19.3	25.1
Higher Secondary	179	29.7	2.7	10.7	13.4
College	83	69.2	6.2	8.3	14.5
Total	3028	391.6	35.3	72.6	107.9

It may not be out of place to mention here that the recurring cost of running the educational institution is very high. Hence such a measure for double shift function in new Primay and High Schools may be considered as a policy to meet the exigencies of scarce financial resources for meeting alternative community and other services for the teeming urban population of the CMD. □

UNIVERSAL PRIMARY EDUCATION AND CALCUTTA POOR

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THIS paper attempts to examine the existing programme of universal primary education and the problems of popular participation in the programme in urban areas of West Bengal and particularly in Calcutta.

Article 45 of the Indian Constitution

visualised that free and compulsory education for all children till the age of 14 would be provided by 1960. Third Five Year Plan envisaged the completion of the programme by 1966. In the Draft Fifth Five Year Plan it was stated that "At the end of the Fourth Plan, educational facilities will be available for about 84 per cent of the children in the age-group 6-11 and 36 per cent in the age-group 11-14." It further stated that "In the Fifth Plan, the objective is to cover 97 per cent of the children in the age-group 6-11 and 47 per cent in the age-group 11-14." West Bengal can certainly claim success in regard to making near universal provision for free primary education for the age-group 6-11.

The programme of universal primary education has however, three components: one, universal provision of educational facilities, two, universal enrolment, three, universal retention. It should be borne in mind that universal provision of educational facilities do not necessarily ensure universal enrolment and universal enrolment does not necessarily guarantee universal retention. Second All India Educational Survey made an interesting observation in this regard. It stated, "In Bihar the percentage of population having primary sections available within a convenient walking distance is higher than in Kerala. The lowest percentage of enrolment in Bihar indicates that in spite of the fact that schools are available on a large scale (more or less on a universal basis) the enrolment has been lagging behind seriously"[1]. It appears however, that Second Survey and the subsequent Surveys failed to attach due importance to the implications of the above facts. Our planners are used to hammering on cost problems which are primarily related to the component number one of the programme of universal primary education. They usually over look the structural and attitudinal hindrances to universal primary education which are related mainly to the last two components of the programme.

It is interesting to note that according to different educational surveys the enrolment ratio is higher in rural areas in West Bengal than in urban areas but retention rate has been found to be higher in urban areas than in rural areas. It only indicates that universal enrolment which is a basic condition for universal education does not automatically lead to universal retention.

We shall now examine the programme of universal primary education in terms of the above three components, as they have been implemented in the urban areas of West Bengal with particular reference to Calcutta.

Universal Provision of Educational Facilities

According to Fourth All India Educational Survey, 1978, there were 50267 primary schools including primary sections of Middle and High schools, in West Bengal. About 41 thousand of them were located in rural areas while more than 8 thousand were in urban areas[2]. In West Bengal there are 38,074 habitational villages and 291 towns including cities[3]. These 291 towns have more than 8 thousand primary sections. According to Third All India Educational Survey, 1973, there were more than 7 thousand primary sections in urban areas of West Bengal. In Calcutta there were altogether 1637 primary level educational institutions according to Third Survey[4]. Calcutta Corporation itself runs 287 free primary schools[5]. Actual number of primary level institutions would have been a little more if unrecognised private primary schools were included in the Survey. According to Calcutta Metropolitan Development Authority, there were 2111 primary schools in Calcutta in the year 1974-75[6]. It can be safely estimated that there were in Calcutta atleast 2500 primary schools during the time of Fourth Survey.

Fourth Survey estimated a child population of 20 lakhs in the age-group 6-11 in urban areas of West Bengal[7]. Eight thousand four hundreds primary schools for a child population of twenty lakhs means one school for every 238 students approximately.

According to Third Survey estimate, there were 462437 children in the age group 6-11 in Calcutta[8]. Sixteen hundred thirty seven primary schools for four lakhs sixty two thousand children means one school for every 276 children. If we accept CMDA figure for schools for the year 1973, the ratio becomes one school for 229 children of the age-group 6-11. Estimated child population in the age-group 6-11 in Calcutta during the Fourth Survey is 5,72,000[9]. 2500 primary schools for 572000 children of 6-11 age-group means one school for 229 children.

West Bengal has made school education free of tution fees and provided the primary students with free text-books. In many areas mid-day meals or tiffin have been provided for. Number of primary schools is also not inadequate. The ratio of one school for 229 students in Calcutta, where per square km density of population is pretty high, may not be considered unfair. It appears that universal provision of educational facilities have been made in West Bengal including Calcutta. This is however, one side of the story. We will next examine the component number two.

Universal enrolment

According to Third All India Educational Survey 74 per cent of the total child population in the age-group 6-11 was enrolled at the primary level. 78.40 per cent of the rural child population in the same age-group was enrolled at the primary level while only 61.34 per cent of the urban child population of that age-group was enrolled at the primary level. But only 55.29 per cent of the child population in the age-group 6-11 was enrolled in Calcutta[10].

It is interesting to note that in Calcutta during the period 1971-75, the number of primary schools increased from 1030 to 2111 while the enrolment in these schools went down from 2,06,800 to 1,99,094[11].

According to Fourth Survey, 67.60 per cent of the child population in the age-group 6-11 was enrolled in all level of education. 70.86 per cent of rural child population of that age-group was enrolled while only 59.15 per cent of urban child population of that age-group was enrolled[12]. We don't have the figures for Calcutta but it can be reasonably assumed that the enrolment rate in Calcutta also went down, from Third Survey to Fourth Survey as it has happened in case of rural and urban enrolment.

All India Educational Survey figures have been collected from school records. It is a known fact that school records do not give the correct picture of enrolments. School records usually give a inflated picture because of fictitious enrolments. I myself found 25 per cent of fictitious enrolment in a primary school during a field survey. Correct figure of enrolment must be much lower than that of All India Educational Surveys. In a recent survey conducted in 4 villages of two districts of West Bengal it has been found that 55.83 per cent of the total child population in the age-group 6-16 and 50.49 per cent of the child population in the age-group 6-11 are non-enrolled[13].

Even if we accept the All India Survey figures we find that universal enrolment has not been achieved. Besides, the downward trend of the enrolment rate as we find from the Third and Fourth Survey, is trully alarming. The lower rate of enrolment in urban areas generally and in Calcutta particularly, in comparison to rural areas surely indicates the failure of town planners and administrators.

Universal retention

It is interesting to note that though the enrolment rate is lower in urban areas than in rural areas in the age-group 6-11, the retention rate is higher in urban areas than in rural areas. According to Fourth All India Educational Survey, number of students in class V constitutes only 22.92 per cent of students in class I in West Bengal. In rural areas the number of students in class V constitutes only 19.20 per cent of students in class I while in urban areas the percentage in 38.66 of the students in class I. Number of students in class V constitutes only 9.9 per cent of the total students in primary level from I to V in West Bengal. In rural areas the percentage is 8.93 while in urban areas it is 13.26[14].

It is also interesting to note that the enrolment rate is higher at the higher level of education in urban areas in comparison to rural areas. It has been found in the Fourth Survey that 39.01 per cent of total child population in the age-group 11-14 was enrolled in West Bengal. In rural areas only 37.77 per cent of the child population of that age-group was found to be enrolled while 44.23 per cent of child population of that age-group was enrolled in urban areas[15].

It has also been found that total number of students in class VIII constitutes 13.79 per cent of the students of class I in West Bengal. In rural areas the numbers of students in class VIII constitutes only 10.56 per cent of the students in class I while in urban areas it constitutes 27.45 per cent. The total number of students in class X constitutes 7.40 per cent of the total students in class I. in rural areas it constitutes only 5.07 per cent. While in urban areas it is 17.27 per cent[16]. In Calcutta the retention rate is likely to be a little higher.

The higher retention rate and lower enrolment rate in urban areas and lower retention rate and higher enrolment rate in rural areas may be explained in different ways. It may be that fictitious enrolment is higher in rural areas than in urban areas. It may be that urban poor participate in less number in the primary education than rural poor. It may be that inequality in participation is less in rural areas. I have some experiences in conducting educational surveys in rural areas. My experiences do not support the last proposition. I am inclined to believe that fictitious enrolment is higher in rural areas than in urban areas. It is true that generally the higher strata of rural and urban society participate in the primary education programme. Lower strata of both the societies only marginally participate in the primary education programme. But the higher strata of urban society are more aware of the benefit of education and as such are more inclined to continuing education.

It can reasonably be concluded from the above discussion that only the first condition of a programme of universal primary education i.e. universal provision of educational facilities, has been fulfilled. It is difficult to take seriously the claim by the State Minister of education, that 91 per cent of the child population in the age-group 6-11 has already been enrolled in West Bengal[17].

A comparative study of the Third and Fourth All India Educational Survey indicates that the enrolment rate in the age-group 6-11 is going downwards in West Bengal in spite of considerable expansion of educational facilities. It is all the more unfortunate that the enrolment rate in the age-group 6-11 in urban areas is lower than that in rural areas. Urbanisation without education sounds like golden urn made of earth. The danger implicit in such a situation is looming large in Calcutta.

It is interesting to note that workers constitute 37 per cent of total population in Calcutta; 35.52 per cent of the working population of Calcutta is illiterate; 18.52 per cent of the working population has high school level education; 14.58 per cent of them has middle school level education; 13.04 per cent has primary level education and only 7.3 per cent is literate without any education[18]. It is reasonable to assume that labourers constitute the illiterate working population.

It can reasonably be assumed that the bulk of non-enrolled children in Calcutta belongs to the poorer section of the population. It is also known that Calcutta poor lives mainly in slums. There are 300 registered slum clusters in Calcutta. More than one third of the total population of Calcutta lives in slums[19]. Besides, there are 48802 pavement dwellers is Calcutta according to 1971 census. Calcutta Metropolitan Authority has estimated a Bustee population of 16.71 lakhs in Calcutta City in 1983[20]. In another brochure on Calcutta Slums they have put the figure as one million.

Slum dwellers generally send their children to Calcutta Corporation free primary schools. According to Calcutta Corporation Year Book for 1979-80 & 80-81, there are only 40,150 students in the primary schools run by the Corporation. This also indicate the poor response of the slum dwellers to universal free primary education programme of the City authority.

It is high time to take into account the reticent attitudes of Calcutta poor towards the programme of universal primary education. An in-depth study of the structural and attitudinal hindrances to universal primary education in Calcutta is urgently called for. Universal provision of educational facilities is not the only solution to inequal participation in the programme of universal primary education. □

Notes & References

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SEMINAR ON CALCUTTA BEYOND 2000 A.D.

VII. INDUSTRY AND POWER

INDUSTRIAL GROWTH TRENDS IN THE CALCUTTA METROPOLITAN DISTRICT

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OUR beloved city of Calcutta has withstood stress and strain of time through its history of development for nearly 300 years. The city, which had its beginning with only three small villages, has become a humming metropolis with millions of people residing in it and known as a cultural and industrial centre throughout the world. Due to its unique locational advantages like proximity to sources of raw material inputs, well-developed net work of rail, road and water transport and availability of qualified and skilled human resources, Port and market facilities, Calcutta emerged as the prime industrial centre of the country. After Independece much of its locational advantage were lost due to the freight equalisation policy of the Government. This coupled with other various factors, had an impact in the Industrial Development of the State including Calcutta during the post-independence period and West Bengal had to concede its prime industrial position to other States.

As in case of all cities which developed historically and spontaneously, Calcutta has reached a stage where all concerned should contribute their due share for a planned development of the city so that it can be a source of joy to our future generation.

Going by the past experience, it is rather difficult to project an idea about what will be Calcutta beyond 2000 A. D. However, let us accept the projections made by some experts that from now to 2000 A. D., additional employment of about 20 lakh people will be required to be provided here. Assuming that the industry and construction sector will be called upon to meet 40% of the projected employment requirement, serious efforts for proper planning and execution as per plan is required to meet the challenge.

As you know, the industrial activities in the country are governed by the Industrial Development & Regulation Act, 1951 enacted by Government of India. As per the latest Guidelines, but for some relaxations no new industrial activities including substantial expansion etc. are allowed within the Standard Urban Area of Calcutta as defined in the report of Census 1981. This covers virtually the entire area which we normally project as the future Calcutta Metropolitan. This includes the entire Calcutta Corporation area, most of the districts of 24-Parganas, developed parts of Hooghly, Howrah and Nadia. Therefore, so far as Calcutta is concerned industrial development should confine itself to a very limited field of activities. However, I find no reason to be disheartened because of this. As you all know, the most potential fields of industrial developments are electronics and chemical industries. The State Government has already appreciated the need for taking effective steps towards this direction and the West Bengal Electronics Industries Development Corporation is functioning for this purpose since 1974. An industrial Estate has already been set up in Calcutta by W. B. E. I. D. C. The Corporation have 140 acres of land in Salt Lake city near to the Calcutta Airport. Electronic units located in the developed area of this State are eligible for incentives provided to other industries located in the backward areas. The Haldia Petrochemical Project, when implemented, will also provide a new impetus to the industrial development of this state the impact of which will definitely be felt in this city.

As you know, Kalyani, although it falls within the Standard Urban Area of Calcutta, enjoys relaxation to the locational policy of the Government of India as it was developed by the State Government for industrial purposes prior to December, 1977. A large number of industrial units have already come up there and many more are coming and will be coming up in the near future. Apart from the established growth centres, the West Bengal Industrial Infrastructure Development Corporation have already acquired 150 acres of land at Birshibpur near Uluberia, in the district of Howrah and there is also a proposal for having an eighty acre growth centre at Budge Budge in the district of 24-Parganas. Both the locations are very near to and well connected with Calcutta.

Another notable factor in the industrial development of the State as well as Calcutta is setting up of an Export Processing zone at Falta. Initially, this will have an area of 105 acres of land. So far as my information goes through different stages of implementation, the Falta FTZ will have an area of 460 acres of land. The work on the project is progressing fast.

So, although there is very limited scope of development of industry in the organised sector within Calcutta, there is immense potential for industrial development at places very near Calcutta. This is especially at the Falta FTZ where many industrial entrepreneurs are already exhibiting considerable interests.

Coming back to the need for providing additional employment to about ten lakh job seekers of the city in industry during the ensuing twenty years, I would like to observe that the prevailing locational policy makes the proposition a bit difficult for us. Dedicated effrots are required to find proper solution to this problem.

For this purpose, the related planning and promotional agencies are required to make long-term planning through proper co-ordination and exchange of views. Development of industry in the large and medium sector in the aforesaid locations should be planned in a manner so that they would provide maximum scope for development of ancillary and downstream projects in the small scale sector in and around Calcutta.

There is also a need for betterment of functioning of the existing industries of the city. The major industries of Calcutta are Jute and Cotton textiles, Engineering, Drugs and Pharmaceuticals. Most of the industries need modernisation and replacement of obsolete plant and equipment. Modernisation does not necessarily mean that costly imported plant, equipment and know-how should be procured. Modernisation should cover all fields of activities of an industry, be it planning including manpower, costing, product development, organisation of manufacturing activities, packaging or marketing. This is especially relevant to our industry as many of them because of historical reasons adopt systems and procedure which are often detrimental to the health of the industry itself.

Power is one of the essential factors for industrial development. The Government is aware of the difficulties the present power position has created. A number of measures both short-term and long-term has been initiated to tide over the situation. The use of diesel-generating sets has come to a great help in meeting the shortage of power supply. Many of the industrial units have now their own captive generating sets and most of these generating sets are diesel-operated. New industrial units are keeping provision for captive generating sets right from the concept of their own ventures and for this they are eligible for incentives.

Titagarh Thermal Power Station has already started operation and it is expected that on commissioning of the other units of Titagarh and the units (4×210 MW) of Kolaghat Project, the State's immediate power problem will ease to a great extent. It is expected that the present capacity would be augmented by another 330 MW by June 1984. By the end of 1985, another 420 MW capacity is expected to be installed. The Super Thermal Power Project, which is being implemented by the National Thermal Power Commission, would have a target capacity of 2000 MW. By 2000 A.D., it is hoped that some more projects would be commissioned and the power position would improve considerably.

Indian industry has reached a stage when we should no longer look for technological know-how from developed countries only. A large number of research bodies related to science and technology are located either in Calcutta or very near to it. Industry should develop close liaison with these institutes and identify fields of mutual interests. This will facilitate constant improvement of technology and product which in its turn will improve competitiveness of a particular industry.

Under the prevailing conditions, the small-scale and tiny industries are likely to play a significant role in the economy and industry of our city. These industries deserve more attention from all concerned. The beneficiary bigger industries should try to understand the problems of these industries and extend all necessary assistances including technical and management services, as and when required by them. Small and tiny industries often feel that they are being exploited by units where they offer their products and services. The psychological barrier needs to be overcome and a healthy relation of co-operation and trust between the receiver and the supplier is likely to go a long way in enhancing industrial activity here.

It is necessary here to focus our attention to very small units not even falling within the purview of Factories Act. These are units belonging to skilled operators who are at the same time owner as well as worker of the industrial venture. The number of such units in the Calcutta Metropolitan is very large and their industrial contribution is no mean by any standard. These units often work with one or two machines which are virtually junk. The owner, because of poor educational back-ground and financial inability, is not in a position to avail of the various facilities he is normally entitled to. Also, as he has to run the show all by himself, he is not in a position to develop himself or his unit. Ways and means have to be found to overcome these difficulties for providing him with the facilities of modern science and management. Proper organisation and management of these units may provide a new direction of entrepreneural development and self-employment.

To cope with the need for providing facilities for sustenance and growth of commercial and industrial activities and also for extending modern civic aminities to the growing population, various organisations have involved themselves in implementing well-planned projects. The Sub-way system at Howrah Station, Fly overs in various parts of the city are examples of already-executed projects. The work on the Second Hooghly River Bridge and Metro Railway when completed will go a long way in betterment of the transport system here. Since communication and transport have direct bearing on Commerce and Industry, development in this field of infrastructure will naturally be reflected on the economy of Calcutta. At the same time, all such development activities should be undertaken without disturbing ecological balance and environmental pollution. This is especially relevant to the planning and development of industry which will continue to flourish. I call upon all concerned to involve themselves with the development of this city so that our children may lead a happy, prosperous as well as creative life. ☐

PROBLEMS OF INDUSTRIAL GROWTH : A STRATEGY OF SURVIVAL

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THE state of industry and power in Calcutta in 2000 A. D. is essentially a study in futurology. Crystal ball gazing in the future would be a meaningless exercise unless the past, the present and the trend are analysed and thereafter an extrapolation is done for the future.

When Job Charnok landed in Sutanuti in 1686 and together with the villages of Gobindapur and Calcutta formed the nucleus of Calcutta, little did one imagine that the cluster of three villages would ultimately be transformed into the great megalopolis that is Calcutta today. The city of Calcutta at one time was circumscribed by the so-called Maratha ditch and even in our younger days when people from Bhowanipore or Ballygunge journeyed across the Lower Circular Road boundary, they used to say that they were going to Calcutta. Today, greater Calcutta is a vast urban complex with expanding frontiers. This enormous conurbation of the city complex of greater Calcutta is the focal point of economic activities of the entire eastern region comprising the vast hinterland of West Bengal, Bihar, Orissa, Nepal, Sikkim, Bhutan, the North-Eastern States and the eastern part of UP.

In spite of its awesome size and its bustling activities and its critical significance in the national and regional economy, Calcutta is a city in dire crisis. All who live in this huge metropolitan complex have daily experience of its characteristic problems—chronic deficit in basic utilities such as water supply, sewerage and drainage ; in community facilities such as schools, hospitals, parks and recreational spaces ; severe unemployment and under-employment which tend to tear asunder the social fabric of the community life ; the under tone of soothing violence ; congested and inadequate transportation ; vast housing shortages and proliferating slums ; soaring land prices and rent ; the unending flow of rural population ; a near collapse in the telecommunication system and so on and so forth with limited state and municipal financial resources to cope with the situation.

Over the past 200 years, many committees and commissions have met and deliberated on the problems of the city and issued reports calling for remedial actions. The improvements that were subsequently made, if indeed any action was taken, were inevitably piecemeal, sporadic and inadequate to meet the needs of the increasing population of Calcutta. Calcutta has grown despite itself—haphazardly, unsystematically and without a suitable structure or co-ordination of the forces of growth and with a diminishing share for each of its residents in the basic amenities of civic life.

The cause of the most acute distress and economic upset in the Calcutta metropolitan areas, as much as in the State of West Bengal as a whole, is the shortfall in power supply. According to the finding of the Power Commission appointed by the Calcutta High Court, the actual supply of power in the area served by the Calcutta Electricity Supply Corporation Ltd. was only 462 MW in 1980/81 as against the unrestricted and restricted demand of 680 MW and 611 MW respectively. Similarly in the south Bengal area, served by the State Electricity Board, the supply was 217 MW on an average compared to unrestricted and restricted demand of 344 MW and 274 MW respectively. A major contributory factor of this acute power crisis is inadequate installed capacity in the State which grew in the decade of the 70's at the average compound rate of 3.2% compared with the national average of 7.6%, and 13.7% for Gujarat, 8% for Maharashtra and 6.1% for Tamil Nadu. According to one official estimate, the shortfall in the State's power supply would rise to 1000 MW by the end of 80's. According to another study, by 1985, there would be staggering shortfall in the south Bengal, including Calcutta metropolitan area, of 2385 MW. Imagination boggles on the shortfall that is likely to occur at the turn of the century.

Admittedly a lot of work has indeed been done in improving civic amenities particularly after the constitution of the Calcutta Metropolitan Development Authority but the pace of progress has been tardy. The gap widens continually and the travail continues.

Coming to the industrial sector, Calcutta which represents the nerve centre of industrial activities in the Eastern Region has fallen from its past pristine glory as the most advanced industrial community in the country to a position of stagnation and in some cases decline. As against a 50% rise in the all-India index number of industrial production during the 70's, the rise in West Bengal was a mere 15%. In the two major industries in West Bengal Jute textiles and engineering, there has been a substantial decline in industrial activities. Cotton textiles, chemicals and pharmaceuticals, where West Bengal had played a pioneering role are in doldrums. The growth industries like electronics, plastics, light engineering, consumer goods are gravitating to other regions.

Indian economy being predominantly agriculture based, the process of industrial development is inextricably linked with development in agriculture. In this area also, West Bengal has lagged behind some of the more vigorous states. So far as agricultural production, area under cultivation and productivity, in the form of yield per acre, the growth rates in West Bengal are considerably lower than the national averages. Green revolution with attendant increase in the purchasing power has somehow or other bypassed the State of West Bengal.

The present situation in Calcutta is the end-product of a number of physical, social, economical and political factors. The impact of partition, the deterioration of the river system, the stagnation of the heavy industries, inadequate progress in agricultural development, lack of development of civic services, the growing unemployment, particularly of the educated and technically skilled--all accentuated by the growing lack of resources and intensified by social indiscipline in many cases—have combined to bring about the present state of affairs in Calcutta which is on one of stagnation, decay and near collapse.

Howrah, the twin city of Calcutta, often called the Sheffield of India because of the large concentration of engineering workshops and skilled labour, has been languishing for years if not decades. Indeed, there is an overall decay in West Bengal's industry. This State, which had occupied the top position in India's industrial map at the time of independence, today has slipped down to the 6th position in terms of per capita value of gross factory output and 7th position in terms of per capita power consumption. This was the position at the end of the last decade and if the trend continues, a negative one in this State and perhaps an accelerating one in other parts of the country, at the turn of the century, in 2000 A.D., we will perhaps witness a piquant situation whereby West Bengal will emerge as an industrially backward State in India.

Yet, Calcutta and West Bengal have many advantages—there is a vast reservoir of coal; the city has adequate technical and managerial skills; the geographical location of the city of Calcutta is particularly advantageous. The paradox, however, remains.

It is, however, an incontrovertible fact that the stagnation and decline of the eastern region hurt rest of India as much it hurts itself. As a socio-political system and as a market, India is an integral whole and every part is dependent on the other. Without oil and timber from Assam, without West Bengal's jute, coal and engineering products and without Bihar and Orissa's mineral resources, the nation's economy cannot progress. Sickness in one limb of the body will lead to the sickness of the entire system. It is, therefore, necessary to carry on with a persistent campaign to create awareness of the inter-dependence of the different regions of India and of the need to deploy additional massive resources into this hapless region. There is an imperative need to draw a perspective long-term plan, preferably over a period of 20 years, for accelerated development of infrastructure, rejuvenation of the agricultural sector and installation of additional power resources together with an increased flow of investment from both public and the private sectors.

In India, it is the State investment that predominantly sets the pace and private sector investment follows in its wake, unlike some of the free market economies of the West where it is other way round. While the Centre would be perfectly right in insisting that the States should mobilise more resources and cut down non-developmental expenditure, the gradual drying up of central assistance for one reason or other would harm the interest of the country as a whole. In this context, an expeditious move in respect of the Haldia Petro-Chemical complex, the Salt Lake Electronics complex, the Dankuni Coal Carbonisation plant, the Falta Free Trade Zone and the Ship Repairing unit in Haldia, is bound to have a multiplier effect in the creation of ancillary and downstream industries. Encouragement to the medium and small-scale entrepreneurs is also necessary. Although on paper, the incentive scheme of the State is quite impressive, they are being implemented in a somewhat unimaginative manner. A more dynamic and aggressive approach is needed to promote local entrepreneurs in setting up medium and small scale industries with attendant benefit of generation of employment in a siseable manner.

There is a need for more intensive drive to survey and to prospect for more mineral sources with particular reference to oil. There is also the imperative need, given the political will, to instil an industrial culture and to improve the work ethics by industrial labour. In the field of agriculture, unlike some of the other regions of India, where owner cultivators dominate the scene and have ushered in what is known as the green revolution, landed interests in West Bengal are still imbued with a feudal look and have prevented the introduction of modern technology. If despite this, a remarkable spurt in agricultural productivity has been witnessed in some districts of West Bengal, it is as a result of the efforts of a very small stratum of cultivators who have in the face of all odds and with very meagre resources adopted modern methods of firming. This only shows the vast potential that is lying latent and that can be harnessed if a programme of land reforms is seriously implemented.

The strategy of survival, if implemented with all seriousness and with the backing of all concerned, should certainly help restore the eminence of the great city Calcutta in 2000 A. D. The alternative scenario is too frightening even to think about. □

SOME ASPECTS OF LIKELY INDUSTRIAL DEVELOPMENT IN CALCUTTA METROPOLITAN DISTRICT VIS-A-VIS WEST BENGAL*

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IN this paper attempts have been made for assessment of some aspects of the likely trend of industrial development in Calcutta Metropolitan District (CMD) Vis-a-Vis West Bengal in the coming years. The analysis has been done based on data available from secondary source of information.

Concentration of Industries in C.M.D.

Calcutta Metropolitan District is the nerve centre of West Bengal's economy and birth place of many Indian Industries. The huming proximity of raw materials, availability of infra-structures, skilled man-power and facility of Calcutta Port accelerated the pace of Industrial development in this region. The Industries located in CMD also share, among others.

(1) 90 % of the All-India capacity of Jute Industry.

(2) 3% of the All-India Cotton Textile Industry.

(3) 60% of the All-India capacity of Wagon Building Industry.

(4) 17% of the All-India capacity of Commercial Vehicle Industry.

(5) 60% of the All-India capacity of Razor Blades Industry.

(6) 10% of the All-India capacity of Paper & Paper Board Industry.

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* View expressed in the paper is the views of the Author and not the organisation where is working.

(7) 60% of the All-India capacity of Rubber Footwear Industry.

(8) 40% of the All-India capacity of Tyre & Tube Industry.

(9) 20% of the All-India capacity of Storage Battery Industry.

(10) 14% of the All-India capacity of Pesticide BHC Industry.

(11) 20% of the All-India capacity of Soap Industry.

(12) 18% of the All-India capacity of Synthetic Detergent Industry.

(13) 19% of the All-India capacity of Match Industry.

Besides, significant capacity of Industrial Machinery Industries, Structural Industries, Re-rolling Industries, Electrical Industries are located in this region. Moreover most of Durgs & Pharmaceutical Units and Mini-Steel Plants of the State and eleven Central Sector Industrial Units are located in the CMD.

The region also shares more than 80% of the total number of registered working factories in the State and more than 30% of the Country's MRTP units.

Problems of the existing Industries in CMD

The major Industries in CMD, particularly jute and engineering industries have some basic constraints. The Jute Industry has the problems of low productivity, lack of modernisation and product diversification and stiff competition in the world market following emergence of Bangladesh as a major exporter and recently China and development of synthetic products in the developed country. The Engineering Industry has the constraints like lack of modernisation and product diversification and freight desparity between Calcutta to Gulf Region (the most potential market of Indian Engineering Industry) and Bombay to Gulf Region. The restriction on the growth of MRTP and FERA unit has affected the natural growth of such industrial units located in the CMD region. Further, most of the existing industries are being affected in respect of economic viability following restriction imposed on creation new capacity in Calcutta Metropolitan Standard Urban Area.

The declining trend of West Bengal in the Country's Industrial Map

The retarding position of West Bengal in the All India Industrial arena as compared with other major Industrialised States is being studied based on Factory Sector data published by C. S. O. during the period of 1961 to 1979-80. The relative growth of major States i.e. Maharastra, West Bengal, Gujrat, Tamil Nadu in respect of parameters like employment, output, value added and their relative position in All India Employment, out-put and value added are determined. The study reveals that West Bengal had the lowest growth in respect of employment, outpu and value-added after 1965 among the major Industrialised States (Tables 1-3).

TABLE 1 : Growth of employment in organised sector in four major States vis-a-vis All India

State	1965	1969	1973-74	1979-80	1979-80
	1961	1965	1969	1973-74	1965
Maharastra	+13.7	+ 9.3	+15.9	+20.2	+52.3
West Bengal	+27.3	− 9.3	+ 3.3	+ 7.9	+ 1.1
Gujrat	+ 9.7	+10.3	+17.8	+18.2	+74.3
Tamil Nadu	+39.5	+19.8	+13.7	+36.6	+86.1
All India	+25.9	+ 7.1	+15.7	+31.9	+63.5

TABLE 2 : Growth of output in organised sector in four major States vis-a-vis All India

State	1965/1961	1969/1965	1973-74/1969	1979-80/1973-74	1979-80/1965
Maharastra	+61.0	+67.3	+71.1	+149.5	+614.2
West Bengal	+63.3	+18.8	+33.0	+115.6	+240.7
Gujrat	+58.0	+70.1	+78.2	+190.5	+779.4
Tamil Nadu	+80.1	+72.2	+61.6	+200.2	+735.7
All India	+68.6	+58.1	+62.3	+167.0	+585.2

TABLE 3 : Growth of value added in organised sector in four major States vis-a-vis, All India

State	1965/1961	1969/1965	1973-74/1969	1979-80/1973-74	1979-80/1965
Maharastra	+47.2	+58.8	+67.5	+117.8	+479.3
West Bengal	+69.1	+ 9.4	+50.4	+ 93.1	+217.9
Gujrat	+32.4	+48.4	+82.9	+133.4	+533.6
Tamil Nadu	+71.5	+53.8	+65.1	+148.1	+530.1
All India	+60.7	+47.4	+42.3	+175.0	+476.8

The time series data further reveals that West Bengal lost her share in the All-India Employment, out-put and value-added after 1965 but the other major Industrialised States maintained more or less consistent share in All-India Employment, out-put and value added during the period 1961 to 1979-80 (Tables 4-6).

TABLE 4: Share of four major States in All-India output in organised sector 1979-80

State	1961 (%)	1965 (%)	1969 (%)	1973-74 (%)	1979-80 (%)
Maharashtra	23.8	22.7	24.1	25.3	23.7
West Bengal	20.4	19.7	14.8	12.1	9.8
Gujrat	9.2	8.7	9.8	10.3	11.2
Tamil Nadu	8.8	8.8	9.5	9.5	10.7

TABLE 5 : Share of four major States in All-India *Employment* in organised Sector

State	1961 (%)	1965 (%)	1969 (%)	1973-74 (%)	1979-80 (%)
Maharashtra	20.7	18.7	19.1	19.1	17.4
West Bengal	20.2	20.4	17.3	15.4	12.6
Gujrat	10.0	8.7	8.1	9.1	9.3
Tamil Nadu	8.2	9.0	10.1	9.9	10.3

TABLE 6 : Share of four major States in All-India value-added in organised sector

State	1961 (%)	1965 (%)	1969 (%)	1973-74 (%)	1979-80 (%)
Maharashtra	27.04	24.76	26.67	31.41	24.9
West Bengal	18.90	19.90	14.77	15.62	11.0
Gujrat	10.46	8.60	8.68	11.15	9.5
Tamil Nadu	8.47	9.04	9.43	10.95	9.9

Reasons for declaration in Industrial Growth in West Bengal

(i) Massive Investment in non-traditional industries in the Central Section Projects viz : Petroleum, Petrochemicals, Basic Chemicals, Drugs & Pharmaceuticals, Electronics and consumer goods during the last 30 years in different parts of the Country, a marginal portion of which came in West Bengal, particularly after the 3rd Five Year Plan.

(ii) The capital generated out of the profits earned has not been re-invested by the industrialists except very few maltinationals for modernisation and product diversification in the existing industries in the State.

(iii) Freight equilisation scheme introduced in the year 1956 in respect of certain selected items viz : Iron & Steel and telescopic railway freight rate for coal which directly affected the locational advantage of the region.

(iv) The freight desparity between Calcutta to Gulf region and Bombay to Gulf region has affected adversely the growth of export oriented engineering industries.

(v) Restriction on the growth MRTP and FERA units under the MRTP Act 1969 and FERA Act 1971. As more than 30% of the Country's MRTP units are located in West Bengal, the said acts have affected the natural growth of existing industries.

(vi) Steady fall in the percentage share of Industrial Licences issued during the period 1965-70, 1970-75, 1975-80 (Table 7).

TABLE 7 : Share of four major States in the Industrial Licences

State	1966-70	1971-75	1976 80
Maharashtra	31.4	25.4	25.8
West Bengal	15.6	9 2	7.3
Gujrat	9.4	9.9	13.6
Tamil Nadu	6.8	10.1	7.3

(vii) Restriction imposed on creation of new capacity by way expansion of existing units or setting up of new units in the Calcutta Metropolitan standard Area.

(viii) Lack of advanced Power Planning.

Dispersal of Industries

Various attempts have been made by the Central Government as well as State Government for dispersal of Industries in other parts of the State from the Calcutta Metropolitan Area While Haldia and Kalyani have already developed as major growth Centres with infrastructural facilities, lack of infrastructural facilities is other area of the State have failed to fulfill the dispersal policy at the State level

Calcutta Metropolitan Standar Urban Area

The Standard Urban Area, a new concept, introduced in 1971 census, is concerned with the area surrounding the core-town that is likely to be urban during the next two decades. It is understood that the concept of constant area of Calcutta Metropolitan Standard Urban Area as mentioned in 1971 census has been changed in 1981 census as the area has increased further and the same poses serious threat on industrial economy of this region in view of the present restriction on creation of new capacity.

Strategy for Industrial Development

We cannot think planning for Industrial Development of CMD area in isolation [illegible] the rest of West Bengal. To get the [illegible] of Calcutta beyond 2000 A.D. we have [illegible] evolve long term perspective plan for Industrial Development in the State covering the period 1986-2000. For drawing the perspective plan, the State of West Bengal may be divided into the following groups.

Group A : (i) Calcutta Municipal Corporation.
(ii) Howrah Municipal Corporation.
(iii) Garden Reach, Metia Bruz, Mahestala, Behala, Jadavpur, Tollygunge and Sonarpur P.S. in the South of 24-Parganas.
(iv) Bijpur, Naibati, Jagatdal, Noapara, Barrackpore, Titagarh, Khardah, Belgharia, Baranagar, Dum Dum Police Stations in North of 24-Parganas.
(v) Bally, Liluah Police Stations in the Howrah District.
(iv) Serampore, Uttarpara, Chinsurah, Singur, Chandannagar Police Stations in Hooghly District.
(vii) Kalyani Police Station in Nadia District.

Group B : (i) Barasat, Rajarhat Police Stations in the North of 24-Parganas.
(ii) Domjur, Panchla, Sankrail, Uluberia Police Stations in Howrah District.
(iii) Baruipur & Budge Budge Police Stations in South of 24-Parganas.
(vi) Mogra, Polba, Chanditala Police Stations in Hooghly District.
(v) Chakdah Police Station in Nadia District.

Group C : (i) Area excluding the area as indicated in Group A and Group B in South of 24-Parganas.
(ii) Area excluding the area as indicated in Group A and Group B in North of 24-Parganas.
(iii) Area excluding the area as indicated in Group A and Group B in Howrah.
(iv) Area excluding the area as indicated in Group A and Group B in Hooghly.
(v) Area excluding the area of Gr. (A) and Gr. (B) in Nadia District.

Group D : Districts of Burdwan and Midnapore.

Group E : Districts of Birbhum and Murshidabad.

Group F : Districts of Darjeeling, Jalpaiguri, Cooch Behar, Malda, West Dinajpur, Bankura and Purulia.

It will be wrong to keep out all types of industries from CMD. The expensive infrastructure created in CMD should be fully utilised. The unutilised capacity in the existing medium and large industries may be fully utilised by way of product diversification. There is large scope for substantial expansion in many existing medium and large industrial units in the CMD Area.

The existing medium and large industries located in Group-A may be allowed for product diversification and substantial expansion. The present restrictions on creation of new capacity may be continued only for setting up new units in Group-A area for which no additional land is available. The existing medium and large industries located in Group A area may be allowed for product diversification and substantial expansion if no additional land is necessary otherwise the present restrictions on creation of new capacity will not only affect economic viability of the existing industries but also will affect present employment in the industrial sector in the region.

Setting up of new medium scale industrial units shall be allowed in the Group B area.

In Group A and Group B area CMDA may set up industrial estates of vertical type for small scales units such as drug intermediates consumer electronics, lether goods, machine tools etc. in view of shortage of land.

Two new growth centres may be developed in each of Group C (i) area, Group C (ii) area, Group C (iv) area, Group C (v) area and one growth centre may be developed in Group C (iii) area for setting up medium and large industries. Futher one more new growth centre may be developed in each of the districts of Group (D) area—and at least one growth centre may be developed in each of the districts of Group (E) and (F) areas for balanced industrial development in the medium and large scale industrial sector in the State. These growth centres may act as nucleus for development of small scale units in different districts at the State level.

Special emphasis may be given for development of non-traditional industries in the above mentioned growth centres.

The perspective plan for the years 1986-2000 may be framed keeping view the rate of industrial growth which took place in West Bengal during 1961-66 as well as the high-rate of growth which took place in other parts of the Country during 1967-80.

Action programmes may be taken at an interval of every three years to implement the long term planning of 15 years.

As no primary data base of industrial sector is available for preparing long term planning we request the CMD Authority to take up a project to get the information on important industrial parameters at least in the medium and large scale sector which will be used for framing the perspective plan. CMD Authority may take up another project on input-output Matrix in the industrial sector at the CMD vis-a-vis State level which would be useful to form the strategy of the long term perspective plan. ☐

LETTERS TO THE EDITOR

Effects of growth and respiratory regulators on diosgenin synthesis in *Costus speciosus* (Koenig) Sm.—I. Experiment with vegetative plants

Steroidal drugs derived from diosgenin, a natural product of *Dioscorea* and *Costus* spp., have wide application in medicine. Out of total world-wide pharmaceuticals, steriodal formulations account for a sale of $ 1500 a year. To meet India's requirement of diosgenin at the end of sixth five-year plan, availability of *Dioscorea* tuber needs to be increased to at least eight times on the assumption of 2.5-3% recovery. Unfortunately India, at present, hardly produces about 30-40 tons of diosgenin, thus leaving a wide gap for taking up commercial cultivation of steroid-yielding plants on specific lines. Cultivation of *Dioscorea* is expensive and hence after limited agro-technological trials of *Costus speciosus* (Koenig) Sm.[1], the same has been identified as an alternative source of diosgenin raw materials[2,3]. Panda[4] introduced successful cultivation of *Costus* spp. in Darjeeling Hills. The present study reports the effects of foliar application of some growth and respiratory regulators on diosgenin synthesis as well as changes of some biochemical parameters in *Costus* plants.

Plants of *Costus speciosus* (Zingiberaceae) were grown from 50 gm rhizome pieces during April in Mungpoo hills of Darjeeling district, West Bengal. These were fed with 100 ml respiratory inhibitors like maleic hydrazide (MH), potassium thiocyanate (PT), respiratory promoters like sucrose (SU), Citric acid (CA); growth promoters like α-napthalene acetic acid (α-NAA), gibberelic acid (GA_3) and growth retardants like chloro-choline-chloride (CCC) through leaves during morning hours, followed by covering the plants with 20/μ polythene bags for 6 hr.

Quantitative data on total nitrogen (TN), reducing sugar (RS), non-reducing sugar (NRS) and ribose nucleic acid (RNA) along with diosgenin (Dios) were systematically recorded at intervals of 30 days and percentage changes of these parameters were worked out. Eastimation methods followed were of Vogel[5] for nitrogen, of Snell and Snell[6] for reducing and non-reducing sugars, and of Cherry[7] for RNA. Diosgenin analysis were done at suitable intervals following the method described by Panda[4].

Table 1 shows the effects of respiratory promoters and inhibitors on diosgenin synthesis. Diosgenin synthesis was enhanced by SU & CA; concomitant with it, a marked increase of RS content took place. TN content was, however, reduced in these cases. Increase of RNA content was also noted in CA-treatments. Respiratory inhibitors like PT decreased diosgenin synthesis which was accompanied by a decrease of TN and RS contents. In both the cases, RNA content showed high values, being more so in treatments with PT. MH also increased diosgenin which was accompanied by increase of RS, TN & RNA contents and decrease of NRS content.

TABLE 1: Effects of respiratory promoter/inhibitor on TN, RS, NRS, RNA & Diosgenin synthesis in *C. speciosus* during vegetative stages (60-90 days)

Treatment	% increase (+) or decrease (−) over control of				
(μg/ml)	Diosgenin	TN	RS	NRS	RNA
MH 100	+ 4.80	+ 3.94	+66.32	− 10.90	+37.80
SU 100	+18.39	+ 8.54	+63.33	− 26.30	+36.23
CA 100	+26.32	+18.52	+62.39	− 44.88	+48.99
PT 100	−36.72	−21.04	− 9.09	+ 16.30	+17.75

Eeffect of growth promoter and inhibitor on diosgenin synthesis has been shown in Table 2. GA_3-induced diosgenin synthesis markedly, accompanied by appreciable increase of RS and TN contents. As in case of other treatments, GA_3 application decreased NRS and increased RNA contents. In α-NAA, enhancement of diosgenin synthesis was low, remaining associated with increase of RS and RNA contents. Treatments with CCC decreased diosgenin and also TN and RS contents ; but appreciably increased the RNA content.

TABLE 2 : Effect of growth promoter/inhibitor on TN, RS, NRS, RNA & diosgenin synthesis in *C. speciosus* Sm. during vegetative stage (60-90 days)

Treatment (μg/ml)	% increase (+) or decrease (−) over control of Diosgenin	TN	RS	NRS	RNA
α NAA 100	+ 2.48	+ 5.14	+25.00	− 12.10	+24.95
GA_3 100	+16.51	+12.80	+66.66	− 16.65	+26.91
CCC 100	−18.19	−15.30	−16.64	+ 7.68	+12.02

Active principle synthesis in plants takes place when derivatives of carbohydrates from foliage and ammonia via underground parts are brought together[8]. Gearing of these two components into the mechanism of plant respiration is a pre-requisite for such a macromolecule synthesis[9]. In the context of these two general observations, the experimental findings of the present study would appear interesting. In those treatments where diosgenin synthesis had been promoted in *Costus*, it had invariably remained associated with increase of reducing sugar (RS) and total nitrogen (TN) and decrease of nonreducing sugar (NRS) content. Though not quantitavely reflected, treatments which augmented maximum diosgenin synthesis (*viz.*, GA, SU, CA) also enhanced RS content to a maximum ; whereas changes in other two parameters remained somehow related to diosgenin content. Changes in RNA content did not reveal any clear pattern ; the same had been increased in almost all the treatments irrespective of increase or decrease of diosgenin synthesis.

A destruction could be drawn in the manner of effects induced by two inhibitors MH and CCC. While MH augmented diosgenin synthesis, CCC inhibited the same. In case of other biochemical parameters also, contrasting effects were clear with the singular exception of RNA, which increased in both the treatments ; MH-applicable, however, revealing a comparatively high augmenting effect of RNA contents. Such a phenomenon would point out to an indecisive role of MH in plant growth and metabolism, as also pointed out in other reports[10,11].

The present study has been conducted with *Costus* plants during vegetative stage of development and studies with reproductive and post-reproductive stages are in progress.

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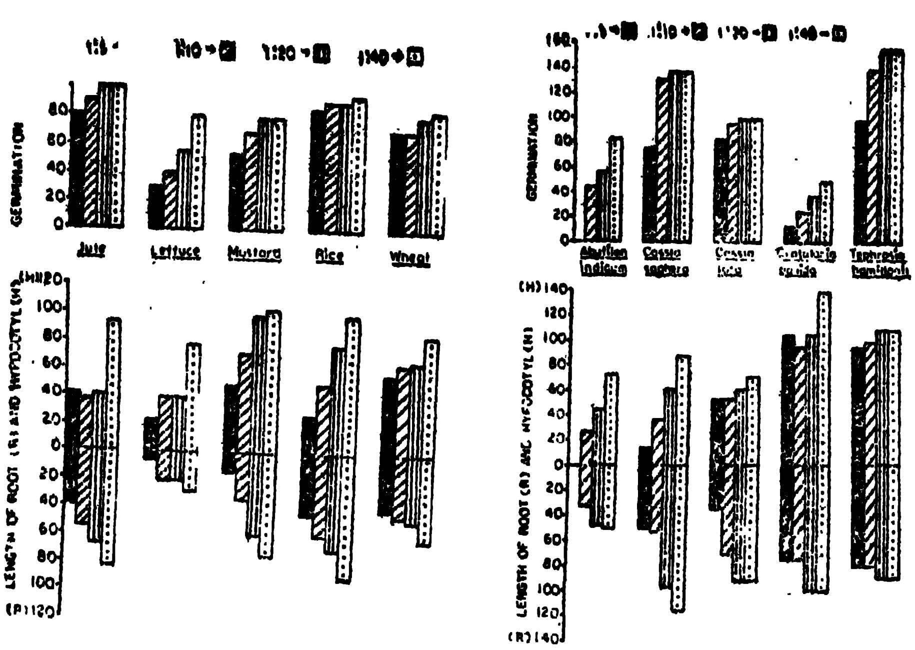
Allelopathy in *Borreria articularis*: inhibition of seed germination and seedling growth

In recent years, the phenomenon of allelopathy, i.e. one higher plant exertin a harmful influence on another by the production of chemical retardants or phytotoxins, has come into the limelight[1-7]. That allelopathy has major roles in natural and manipulated ecosystems is well-documented[8]. However, our knowledge pertaining to the allelopathic potentialities of the weed flora of India in general and West Bengal in particular is very meagre[9]. A study was initiated to determine the possible occurrence of phytotoxins or germination and growth inhibitors in local weeds and their implications as a habitat variable.

The present report deals with the allelopathic principle associated with leaf-extracts of *Borreria articularis* (L.f.) F.N. Will. (Syn. *Spermacoce hispida* L.), a common herbaceous weed[10] found throughout India[11]. It often becomes parennial[12] and is seen up to 3,000 ft in the hills, on the coastal sands and on all drylands in the interior[13]. The plant has long branches, hispid leaves, pale mauve flowers, ellipsoid capsules and oblong-granulate seeds[14]. The allelopathic action of the plant was detected on a host of crop plants —jute (*Corchorus olitorius* L. cv. JRO-632), lettuce (*Lactuca sativa* L. cv. Sutton's improved unrivalled), mustard (*Brassica campestris* L. var. *dichotoma* Watt.), rice (*Oryza sativa* L. cv. Ratna), wheat (*Triticum vulgare* L. cv. Sonalika) and weeds—*Abutilon indicum* (L.) Sw., *Cassia sophera* L., *C. tora* L., *Crotalaria pallida* Ait. var. *pallida* Ait. and *Tephrosia hamiltonii* J. R. Drumm. Vigorously thriving individuals of *Borreria articularis* were collected from Agartala. Aqueous extract was prepared by crushing 20 g of leaf material in a Bajaj mixer with glass-distilled water. It was filtered and the filtrate made up to 100 ml by adding water. This filtrate served as the stock solution of 1:5 concentration. Various bioassays, with crop and weed seeds named earlier, were used to judge the inhibitory activity of the leaf extract. Surface-sterilised seeds (by 2% sodium hypochlorite for 10 min) were scattered on a single disk of filter paper in 9-cm diam sterile Petri-dishes and 10 ml test solution or water was added to each of the four replicates. The number of seeds in each dish was variable: 20 for crops and 25 for weeds. While the crop seeds did not need any pretreatment before the start of the experiment, the weed seeds were chemically scarified for 20 min (except *Abutilon indicum* for 2 hr) by treatment with conc. H_2SO_4 and followed by washing throughly in water. The dishes were kept at 28 ± 3°C for three days except for rice which was five days. The emergence of radicle was chosen as the basis for germination. The data are presented as per cent of germination as well as average length of root and hypocotyl in terms of the corresponding controls.

A concentration of 1:5 was strongly inhibitory, but the effect became gradually reduced upon dilution (Figs. 1 and 2). Among the crop seeds, lettuce germination was highly inhibited; this was followed by mustard, wheat, rice and jute (Fig. 1). While the root and hypocotyl growth of lettuce seedlings was reduced at all concentrations of the leaf-extract, this was true for other crops up to 1:20 concentration. The root growth was lowered more than the hypocotyl growth particularly in lettuce, mustard and wheat.

Among the weed seeds, *Abutilon indicum* failed to germinate in the presence of 1:5 concentration of the leaf-extract and germination of *Crotalaria* was curtailed at all concentrations (Fig. 2). At the maximum concentration, the germination of *Cassia sophera* seed was considerably inhibited. There was no germination inhibition in *C. tora* and



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Figs. 1 and 2. Allelopathic influence of *Borreria articularis* on seed germination as well as root and hypocotyl growth ; (1) As revealed by bioassays with crop species ; (2) As revealed by bioassays with weed species.

Tephrosia hamiltonii, especially at lower concentrations (1:20 and 1:40). The root and hypocotyl growth of *Abutilon indicum* decreased at all concentrations, though the root and hypocotyl did not appear in 1:5 concentration. Whereas the hypocotyl growth was not suppressed in *Crotalaria* and *Tephrosia*, the root growth in these two seedlings was restricted at higher concentrations (1:5 and 1:10). The hypocotyl growth of *Cassia sophera* and *C. tora* was more adversely affected by the leaf-extract than the corresponding root growth, particularly at lower concentrations (other than 1:5).

It is concluded from the above findings that the leaves of *Borreria articularis* are rich in inhibitors, having pronounced allelopathic influences on *Lactuca sativa* and *Abutilon indicum*. Further work is in progress to find out the chemical nature of these inhibitors and their mechanism of action.

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Quantitative conversion of cellulose to sugars

As earlier attempts to hydrolyze cellulose to sugars by mineral acids were not an economic one, enzymic saccharification of cellulosics with prior physical and chemical treatment influencing the rate and extent of hydrolysis was suggested[1-3]. So far no pre-treatment has yet been found to be totally satisfactory for commercial use[4].

In continuation of our studies on the saccharification of cellulosics[5], we pre-treated cellulosics with miscellaneous reagents before subjecting the products to saccharification with enzymes obtained from a hyperproducing strain of *Aspergillus terreus*, isolated here. Among all the reagents studied, we found prior orthophosphoric acid (sp. gr. 1.70, 85%, the acid dissolved about 16% of Whatman filter paper No. 42 or Whatman cellulose powder, No. CC41, under the room temperature conditions) treatment to be the most effective for quantitative conversion (about 96%) of cellulose to sugars. Furthermore, there is potential for recovery and re-use of the acid.

The pre-treatment consisted of treating cellulosic materials (0.5 to 2 gm ; particle size range, 1-3 mm ; without prior removal of lignin) with phosphoric acid (15-20 ml, minimum concentration of acid needed was found to be 80%) for 1-2 hr at ambient conditions. The resulting slurry was later added with stirring to water 1-2 times the volumes of acid used. After allowing the whole to stand for 1 hr, it was filtered. The filtrate could be saved for the recovery of the acid.

To the thoroughly washed treated materials, 20 ml of buffered enzyme solution (0.05 *M*, pH 4.8, 20 FP units/gm of cellulose) was added and the saccharification followed for 48 hr (50°C). Glucose was determined by glucose oxidase[6] and reducing sugars by DNS (expressed as glucose) method[7].

It will be evident from Table 1 that cellulose of different cellulosic materials, was saccharified about 96% of the alpha-cellulose content[3] to sugars (DNS). Glucose made up to 65% (aprox.) of the sugars. That the rest of the enzymic digest was predominantly glucose-oligomers, easily hydrolysable to glucose by additional treatment with HCl (0.25 N, 15 p.s.i for 1½-2 hr), was confirmed by separate experiments (glucose-oligomer was found to be cellobiose by chromatography.

TABLE 1 : Saccharification of phosphoric acid treated cellulosics with fungal cellulase

Dry Cellulosic materials (500 mg)	Alpha-cellulose (mg)	Phosphoric acid treatment	Reducing sugars (mg)	Glucose (mg)	Saccharification (%)
Jute (60.5% alpha-cellulose)	302	—	10.0	6.0	3.0
		+	320.0	250.0	96.0
Newspaper (58% alpha-cellulose)	290	—	130.0	50.0	47.0
		+	300.0	170.0	94.0
Non-absorbent bacteriological cotton (93% alpha-cellulose)	465	—	40.0	20.0	8.0
		+	500.0	330.0	97.0
Corncobs (36% alpha-cellulose)	180	—	100.0	80.0	50.0
		+	186.0	100.0	94.0
Filter paper Whatman No. 1 (98% alpha-cellulose)	490	—	120.0	80.0	21.0
		+	530.0	400.0	98.0

Results not reported here).

As the method presented here has the potential for recovery and re-use of phosphoric acid by absorption and hydrolysis of P_2O_5 obtained from bone ash in the furnace process[9], its commercial exploitation seems to be quite profitable. Moreover, production cost of sugar solution obtained in the present method (maximum concentration obtainable was found to be 12%) from waste cellulosics; will not only be lesser compared to those obtained by cadoxen, cupriethylene diamine[10] and hydrofluoric acid method[11] but would also be very suitable for microbiol fermentation due to absence of any metal ion toxicities in it. Also, the application of the present method, would cause no health hazards, as is likely in the fluoride method[11].

The high saccharification rate observed has, presumably, been caused by decrystallisation (increased hydration), and appropriate depolymerisation[12,13] of the cellulose chains, producing hydrocellulose almost completely saccharifiable by the fungal cellulase used here. For achieving further enrichment of the glucose content of the sugar solution obtained from cellulose, we propose additional treatment with HCl (0.2 N, $1\frac{1}{2}$-2 hr at 15 p.s.i) of the enzyme digest of phosphoric acid-treated hydrocellulose.

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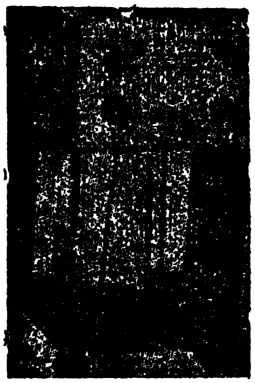

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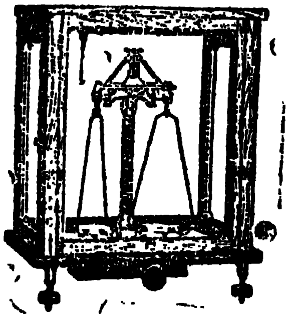

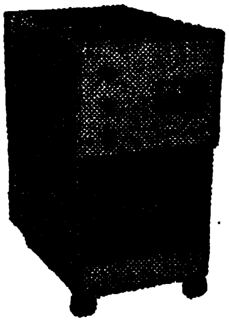

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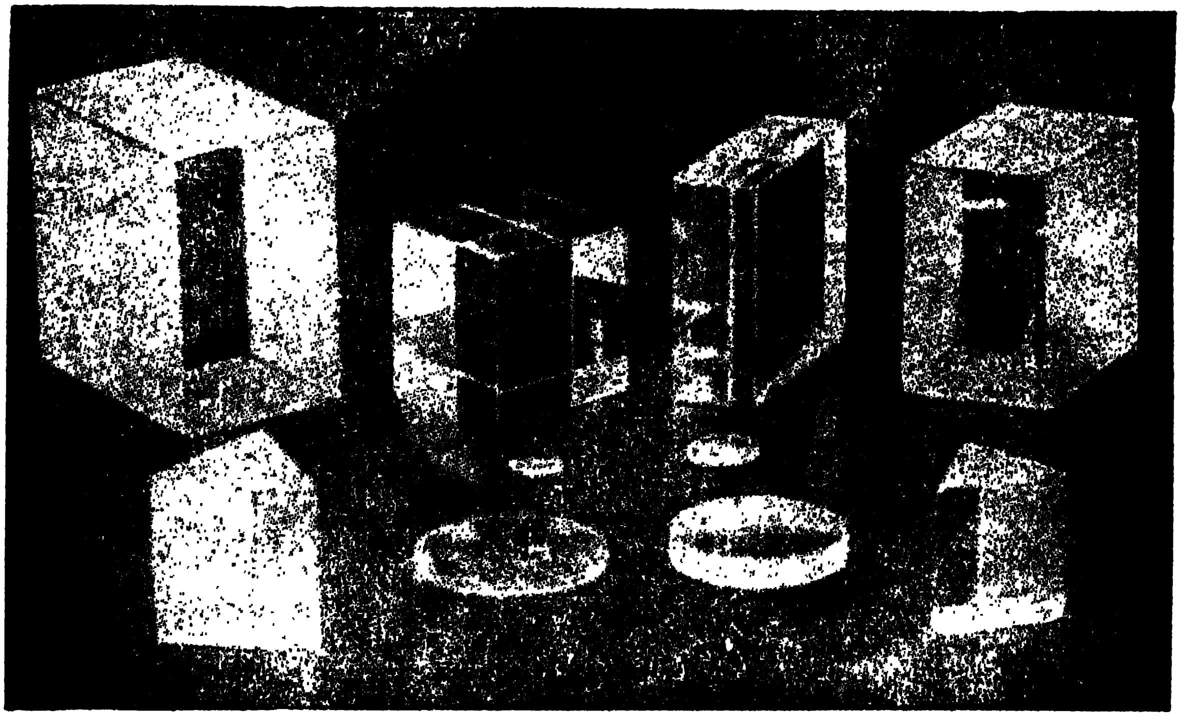

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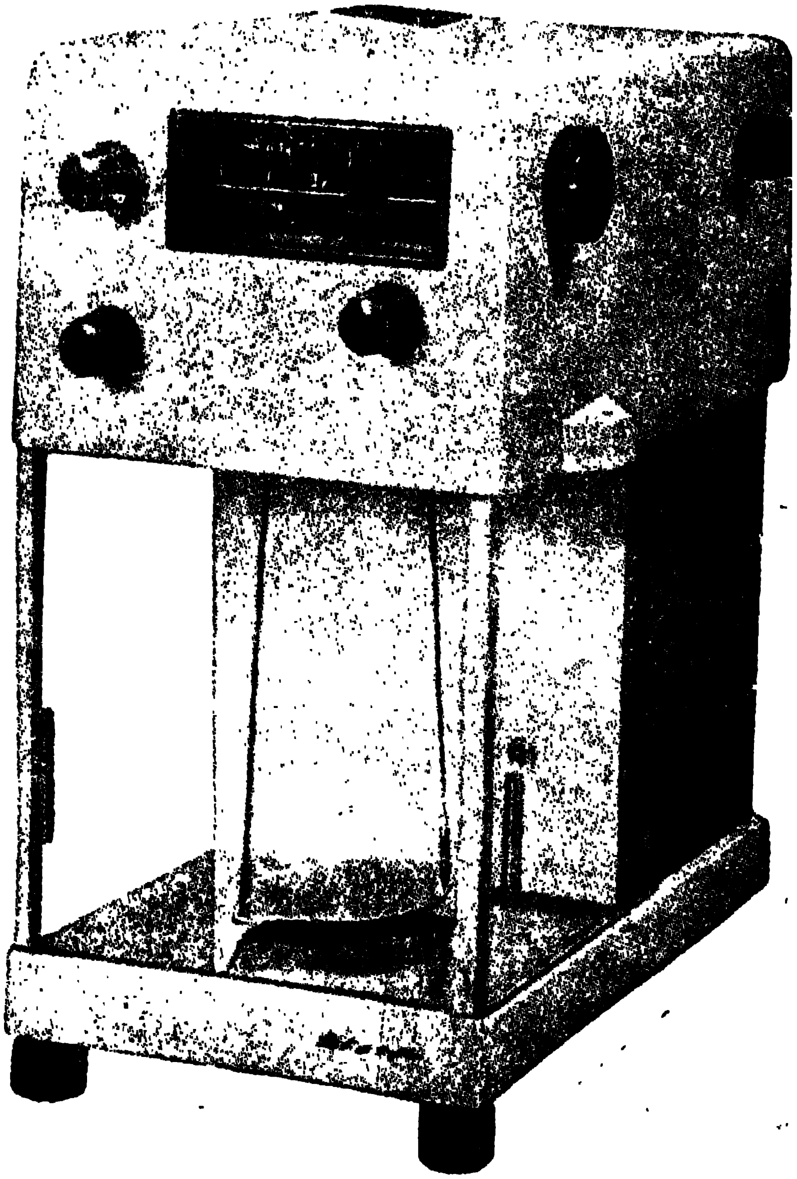

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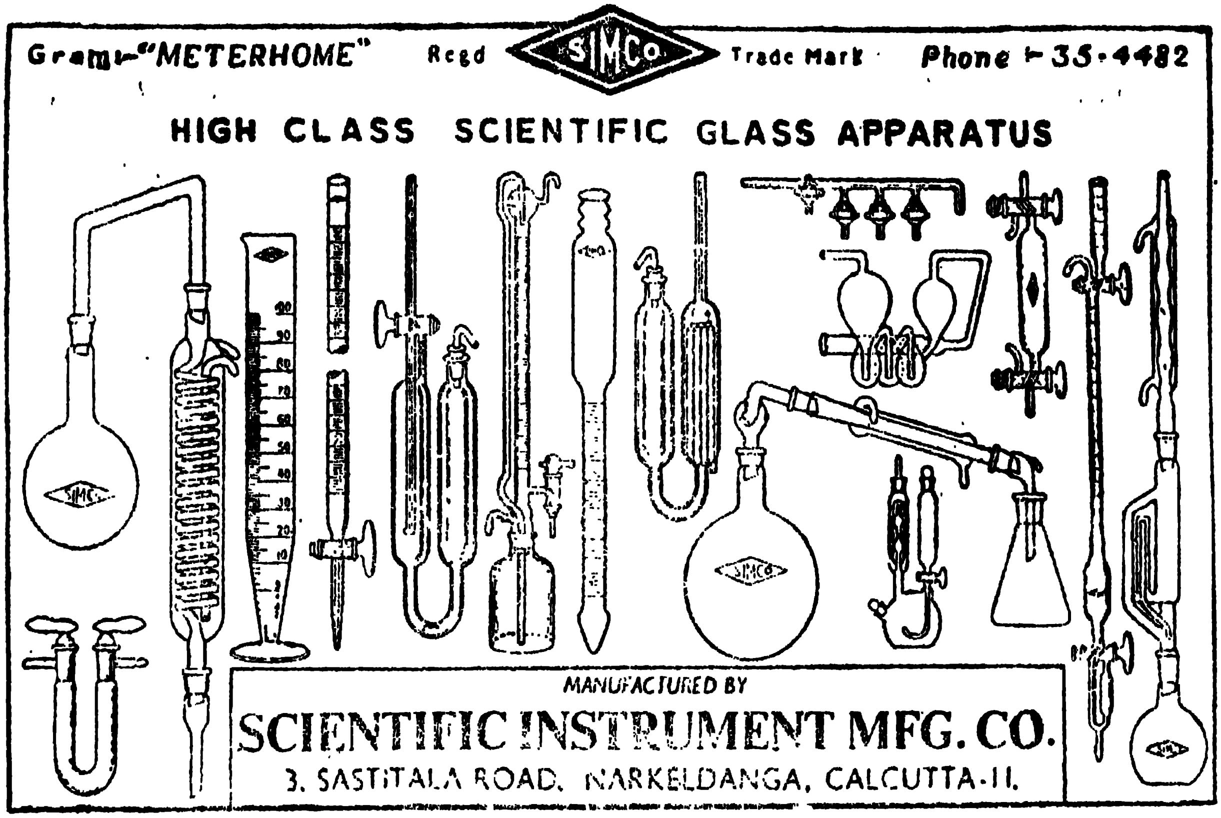

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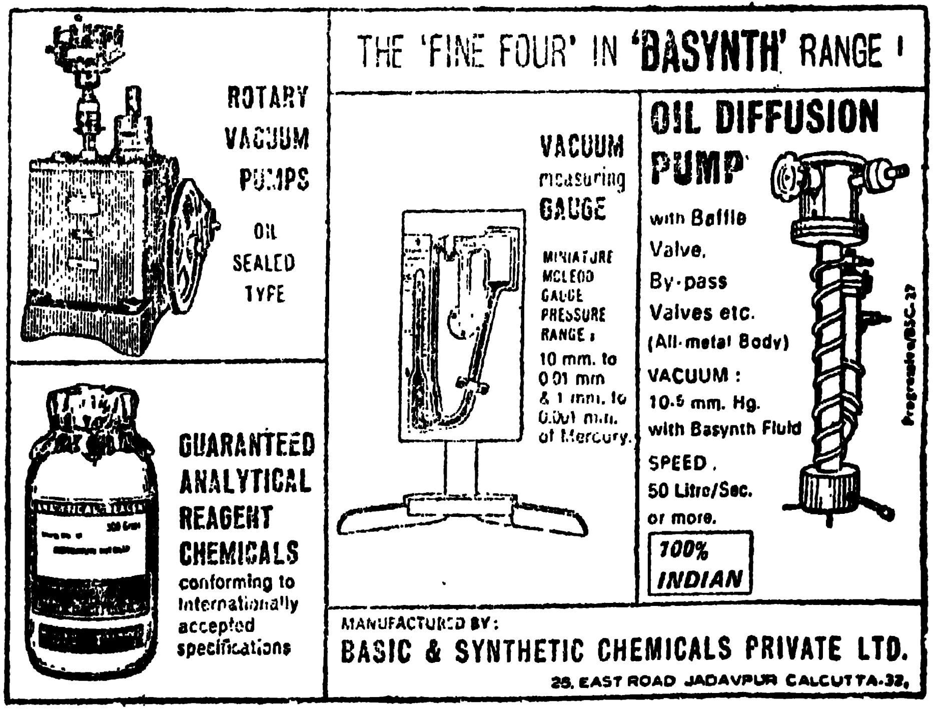

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SCIENCE & CULTURE

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THE FATHER OF MODERN PHYSICS IN INDIA

SCIENCE at the close of the nineteenth century was in turmoil. Out of this developed new ideas, especially in physics, near the beginning of the twentieth century. Einstein's theory of relativity and Bohr's quantum theory of the atom are but a few of the new revolutionary thoughts. These new theories contradicted accepted ideas and even seemed to contradict common sense. As a result many people gave up even the effort to understand them. This difficulty in understanding lies in the novelty of the concepts. Overcoming amazement requires imagination and care. Further perseverence provides a surprisingly correct and simple view of the world. These qualities were exhibited by Meghnad Saha at an early age which led him to the fundamental discovery in physics, the first from India in this century. From this point of view and his perseverence throughout life in modernising the thinking in general, he may be called the father of modern physics in India.

Meghnad Saha hit the international headlines by publishing his paper 'Ionisation in the Solar Chromosphere, in the philosophical Magazine in 1920. With this new directions opened up in astrophysics which with the publication of the companion paper 'Selective Radiation Pressure and the Radiation Equilibrium of the Solar Atmosphere' in the journal of the Department of Science, Calcutta University, in the same year, brought out further clarification of his ideas.

It is interesting to note that in the second half of the nineteenth century and the first couple of decades of the twentieth century heaps of data were collected on the spectra of different stars, the prominent amongst them being our closest star—the sun. However, the identification of elements in these data in comparision with the spectra of elements on the earth was rather confused. Certain puzzling facts in the spectrum of solar chromosphere were revealed in the intensive and systematic study of the chromosphere during the total eclipse. It was found that the H and K-lines of calcium were much higher than the corresponding lines of the lighter elements like hydrogen, helium or sodium. This was a great puzzle.

By nature, Meghnad Saha was interested in all that is new and novel from his childhood and tried to understand any phenomenan in his own way. This character was channelised in his youth in physics and he tried to grasp veraciously the new concepts in the field. He quickly mastered the quantum theory of radiation and deduced the existence of the pressure of light. He exhibited the working of these ideas in a selective manner on different atoms. It was known that high temperatures existed inside the stars and Eddington had suggested that atoms would be ionised at these temperatures but he did not indicate the mechanism of ionisation. However, John Eggert a young physicist working in the laboratory of Prof. Nernst in Berlin tried to justify this ionisation on the basis of reaction isochors. However, he used hypothetical values for ionization energies of elements. Saha got the cue and immediately understood the implications. Applying his knowledge of Thermodynamics and chemical constants, Saha formulated his theory of thermal ionization in which he used exact values of the ionization energies from the spectral data and from the experiments on ionization potential that were available at the time. His deep knowledge of astrophysics immediately found application to this new theory—the explanation of peculiarities of the solar atmosphere. It explained clearly, for the first time, the disappearance of arc lines from the higher layers and the intensification of the spark lines in the solar atmosphere as an effect of reduction of pressure.

At the end of 1920, Meghnad Saha went to Europe on the Ghosh Travelling Fellowship of Calcutta University. He spent quite some time at the Imperial College in Prof. Fowler's Laboratory. It was here that he wrote his other monumental paper on a Physical Theory of Stellar Spectra. From London he went to Berlin to Prof. Nernst's laboratory. Here he could communicate directly with many of the leading scientists of the time and Prof. Saha was well equiped with the German language as that was the language scientists commonly used. Even though his stay was short he could publish about six papers during this sojourn.

Once the heat of applications in the field of astrophysics cooled down to a certain extent, the theory of thermal ionization found applications in numerous other unconnected areas, such as conductivity of flames, electric arc, explosion phenomena, the study of ionosphere, etc. The import of the fundamental theory started unveiling in these applications. These days it is finding extensive use in the study of hot plasma and magne-to hydrodynamics.

Universality of application is the nature of any fundamental theory. But the conception, depth and formulation of the theory requires a well disciplined mind. So it is natural for any one to have inquisitiveness about the training and tribulations of Meghnad Saha in his early years.

Meghnad Saha was born on October 6, 1893 in a remote village in Dacca, called Seoratali. He belonged to a trading community. Born as the fifth child of his parents, with meagre family income, Meghnad did not feel much welcome but saw want everywhere around. In this quagmire of shortages and deprivations, he found great pleasure in learning at the primary school of the village. His father did not have any intention of educating his son beyond this stage, but the child's aptitude and keenness to learn more prompted his teachers to persuade the elders to continue the education of Meghnad. His elder brother, Jaynath, took great interest in bringing up his younger brother and it was he who was instrumental in giving the scientist to the world at large. Meghnad's school days and college days were full of difficulties and suffering. Many were the complexes which he had to overcome but he was steadfast in his goal of higher learning and training the mind. The keen and observant village lad absorbed fresh and pure from the village life sifting the miseries. This was done without any ado or calling attention to and his life, until he came and completed his conventional education in Calcutta in 1915, was just about ordinary. He joined as a lecturer in physics in the newly founded science college in the following year and started lecturing on diverse topics in physics and mathematics. To teach the post-graduate students Meghnad Saha worked hard by getting acquainted with the latest concepts in physics. As physics used to be written in German, he mastered German language which initiated him into the realm of research. His first paper in Philosophical Magazine appeared in 1917 on 'Maxwell stresses' and in the following year Calcutta University awarded him the D.Sc. for his work in the field of electromagnetic field and radiation pressure. Since then there was no looking back, Meghnad Saha forged ahead in the development of

However, his later years brought him to the problems of the society ; Professor Saha served the society through science. Whatever work he undertook, he left an undeniable mark of his. This great life was cut short suddenly on February 16, 1956 while attending s[illegible] work in New Delhi. In this sketch only one aspect of Saha's personality has been dealt which is worth emulating by the young who did not have the opportunity to see this great man. □

B. B. Baliga

PERSPECTIVE PLANNING OF THE UNIVERSE*

S. D. CHATTERJEE**

PROFESSOR Meghnad Saha was a tremendous personality. He was ceaselessly engrossed with problems concerning the application of science and scientific methods to the solution of problems of economic development of our Country in general and Bengal in particular. His importance lay in his being aware of such problems earlier than others, in his capacity for rapid mastery of the essentials of the problems, his matchless publicity campaign focussing public attention to them, putting forward some concrete solutions, and in severely criticizing government plans when necessary.

Upto 1930, Saha was deeply engaged in teaching and research in Science. In 1952, when he entered the Parliament, Saha explained how the new phase of his activities, which dealt more with organization of research and the application of Science to national development problems began. He said : "Scientists are often accused of living in an Ivory Tower and not troubling their mind about realities ; Apart from my association with the political movement of my juvenile years, I lived in the Ivory Tower till 1930".

He founded the Indian Science News Association in 1935. During the period between 1935-53, Saha used "Science & Culture", the journal of the Indian Science News Association, as the vehicle for propagating his ideas on the application of Science to National development.

His important contributions may be briefly categorized as the following :

(1) Organization of Scientific and industrial research ;
(2) Atomic energy and its industrial utilization ;
(3) River Valley development Projects ; &
(4) Planning in general.

I have purposely chosen the last item as the main topic of my lecture entitled "Perspective Planning of the Universe".

One day, during my brief tenure as a lecturer in Physics at the University College of Science, Calcutta, Prof. Saha suddenly entered into my room and suggested that perhaps I could write a book in collaboration with him on a recent topic. When I confessed that I knew very little about the subject he admonished me with the words : "Look, when you know nothing about a subject, try to write a book on it". Saying these words he abruptly left the room. At that time, I was non-plussed. But his words are still ringing in my ears. And so, during the evening of my life, I am undertaking a task in which my comptence is practically nil.

Now, let me begin my theme. The task of science is not complete in providing for the atomic laws, as we know them at present, the story of all the history of the Universe. In the inanimate world we have gone far. Much remains to be done in the great problem of life, and all that it implies.

---

* Eighth M N. Saha Memorial Lecture.

** Formerly Professor of Physics, Jadavpur University, Calcutta.

Let us pause for a moment while we contemplate some of the elements of the fundamental structure—the atoms of matter—from whose potentialities our universe was born. Most of us know that everything around us is composed of some 92 elements. We know also that these elements like copper, iron, hydrogen and so forth are composed of small structures called atoms which in turn are built of certain fundamental particles. These particles are essentially of three types, positively charged particles called protons, negatively charged particles called electrons and neutral particles called neutrons.

At the centre of the atom is a core composed entirely of neutrons and protons. Around this core, at distances which are small, but enormous compared with the dimensions of the core or nucleus, are to be found electrons equal in number to the protons in the nucleus. These electrons perform a kind of dance around the central nucleus which acts for them as a controlling force, dictating their motions as our Sun controls the motions of the planets.

The light atoms have few protons and neutrons in their nuclei, the heavy atoms have many. Thus, Hydrogen, the lightest of all elements has only one proton in the nucleus. Helium, the next lightest, has two protons and two neutrons. One of the heaviest elements, Uranium has 92 protons and about 146 neutrons in its nucleus, and around this nucleus is a ballet of 92 electrons.

It is for the most part of this ballet of dancing electrons which determine the characteristics of any particular atom in relation to its fellows as regards the formation of chemical compounds—compounds like water, for example, whose smallest individual representative, a molecule of water, contains two atoms of hydrogen and one of oxygen. When two atoms come near together, the members of the ballet co-operate to produce a dance more complicated than that of the individual ballets, a dance which locks them into one meaningful structure controlled by the two ballet masters, the nuclei of the two atoms.

Now, the atomic nuclei, composed as they are of protons and neutrons, have their own individual structure, which is practically unaffected by the activities of the ballets. In other wards, chemical phenomena concerned with the combination of atoms have practically no effect on the atomic nuclei, even as the motion of planets, controlled as they are by the Sun, have very little effect upon those dramatic occurrences which we see going on in the Sun itself—the terrific explosions sending flames hundreds of thousands of miles into space, and the many other things with respect to which time, in our present epoch, is enriching our knowledge continually.

It is only comparatively recently and by the utilization of techniques beyond the realm of chemistry, that we have been able to probe the nuclei of the atoms and learn something of the rich store of regularity and law locked in them. In the process of peering into these matters many things have revealed themselves. We have learned that extraordinary things happen when the nuclei, so quiescent in their normal state, become irritated by the treatments to which we can subject them and to which, indeed, they are being continually subjected in such phenomena as cosmic rays. Under the stimuli of such irritations, new kinds of particles can be born and play their role in the picture what happens. Such particles, however, come into existence only in these states of turmoil, and when the nucleus is at peace or when they depart from its influence, they die rapidly and so disappear from the scene. All of these strange phenomena, and the milder phenomena of chemistry, owe their origin ultimately to the law of potentialities of these neutrons and protons which lie locked in the nuclei.

But the story does not end even here for it now appears that the atoms themselves, with their nuclei, represent but an intermediate stage in the development of nature and that, indeed there was a time when there were no atoms—when, in fact, there was nothing but a mass of neutrnos—in the universe, and in the properties of those neutrons, alone, lay all the potentialities of Nature, in the sense that from them were born all the properties of those other things. We have reason to believe that this primordial situation existed some four thousand million or more years ago and that at that time the neutrons, the only material inhabitants of the universe, existed in the form of an extremely dense gas, in company with heat radiation, born itself of the activities of the neutrons. Truly, at that time the universe was without form and void, but we can hardly say that there was darkness on the face of the universe, for the temperature in that epoch is believed to have been of the order of ten thousand million degrees. It is true that at such high temperatures practically all of the enormous amount of radiation present existed in the form of a kind of light—very hard X-rays, in fact, or γ-rays as we call them—to which an eye, if it could have existed, would have been insensitive as regards a recognition of what we call light; but some of the radiation, enormous in total amount although a very small fraction of the whole, would have produced, to a hypothetical eye viewing it, a brilliance far surpassing anything man has ever seen either in the Sun or the atomic bomb.

Our present knowledge of atomic laws enables us to picture the subsequent history of this state of affairs and to realize that as this neutron gas is cooled and expanded with law inherent in the neutrons and their progeny, the radiations, would give birth to protons, which in turn by participating in the story, would cooperate with the neutrons in giving birth to atoms as we know them.

Of course, you may all ask as to the state of affairs which preceeded even that time when all the neutrons were collected as a dense gas and when there were no atoms. Alas, from here backwards the story becomes hazy, but it is not necessary to complete the story in order to understand the subsequent evolution from that period of brilliant chaos which we have envisaged as prevailing when the neutrons and the radiations were the only offspring of the universe; and, we have to realize that even at that time the potentiality of all that has happened since, the potentialities represented in the growth of structure in the universe, in the appearance of planets, and in our own appearance on the scene, with the subsequent development of our civilization, all stem back to the laws inherent in the neutrons in that epoch of the remote past.

And now, I must leave this gigantic story which man, with the knowledge which he has gained from the present, has been able to piece together as regards the past. It is impracticable for me to cite all the details of operation of the laws of nuclear physics pertinent to these matters. It is, however, of interest to point out one or two aspects in which we may call the necessities of out universe were anticipated in the fundamental laws which existed before those necessities were called for by man's existence.

First we have the permanence of matter itself. The steel of which locomotive engines are made does not change overnight into something else or evaporate from view. This fact is, perhaps, a matter of greater astonishment to the man of science than it is apt to be to the layman, for the best a physicist could do until quite recently in the matter of proposing laws suitable to account for the atom's behaviour was to produce laws which would inevitably have resulted in the atom's immediate destruction. Those aspects of the modern quantum theory which are most vital in providing for the permanence of the atoms and so for matter in bulk are aspects which run most contrary to what may be termed our intuitive feelings of common sense.

The existence of radiation such as light, heat, and wireless radiation is a consequence of fundamental laws of physics, and these things form the bases of our communication. Moreover, the photo-electric effect, which is the power possessed by light to eject electric particles from surfaces upon which it falls, and a kindred property that of producing rearrangements of the electronic constituents of the atom when light falls upon it, constitutes a mechanism responsible for our ability to see.

In the Sun, even to-day, the solid state is unknown, and there is no rigidity to anything, yet the strength of steel and of solid materials in general, so necessary for the carrying on of man's activities depends upon characteristic properties of the atoms as they exist in the Sun to-day and have existed in the past inspite of the impossibility of their showing their potentialities in that environment. The easy flow of fluids, their power, as in the case of gases, to expand and contract, are basic to innumerable requirements of the activities of man, and not the least of these requirements imposed by his necessity to breathe.

There is nothing of the nature of a chemical compound on the Sun. There is no water. There are no acids, there are no alkalies. There is no protoplasm. Even the atoms of the elements, as Saha had shown in his classical paper, are for the most part torn asunder. I need hardly point out the importance of Chemical activities to the economy of civilization. Almost everything depends upon them. Man's structure itself and the mechanisms by which he lives are dependent upon them, and all the potentialities for the operation of chemistry are known and anticipated in the fundamental laws which prevail in the Sun, where, however, those laws of chemistry have no chance of exhibiting their activities.

But the fundamental laws of the Universe provide, in their potentialities, not merely for the necessities of existence as we know it to-day, but even for esthetic enjoyments of mankind. It is very convenient for man that there should be a substance as strong as steel. It is very convenient that there should be a substance like water, which will dissolve so many things and perform the multitudinous functions which only water can perform. Perhaps it is more than convenient that there should be a substance like chlorophyll, capable of transforming the Sun's otherwise useless radiation into a form which provides for plant life. It is very convenient that there should be a relatively inert gas like air, which among the many services it performs, can be held to the earth as an atmosphere and form a means of communication through the agency of what we call sound.

Of course, man, himself a part of the whole universe, has played a great part in developing the potentialities of nature's laws. There was nothing to guide him to what he achieved in building a dynamo, a motor, an automobile, a steam-engine, an aeroplane or a cyclotron. And yet, the fact that man can claim credit for having evolved these things does not reduce the wonder inherent in the existence of the possibilities of their being evolved, which possibilities go back to the fundamental laws themselves.

It is an interesting and peculiar fact that in very large number of cases inanimate nature has not waited for men to develop the consequences of what is around him but in concealed form, has frequently used principles and produced devices which, at a later date, man has himself fashioned, only to find that nature has anticipated him. Indeed, if inanimate nature could be endowed with a personality capable of making claims, many of the patent applications of human beings would have to be granted with strict reservations in favour of what Nature has done.

The birds solved many of the problems of flight before man has successfully flown. The structure of their wings and the potentialities for manoeuvrability are marvels of structural design. The jet plane can fly only in the forward direction, while the dragon-fly can fly both forwards and backwards with equal facility.

Lens design is an art invoking highest skill. But the eyes of vultures are better than binoculars. Benjamin Franklin invented bifocal eye-lenses. But nature invented bifocals for some fishes long long ago. The fish found it necessary to swim so that it could see things in the water and at the same time see things in the air above, so it has two sets of pupils to its eyes, one above the other, and it can swim so that one sees what is in the air while the other sees what is in the water.

Science is very proud of its achievements in the detection of small quantities, but until cosmic-ray research in which man has learned to observe individual atomic particles, few of his achievements could compete in sensitivity with his own nose. The power possessed by the dog to follow a scent, is something as yet not understood. The power of the homing pigeon to return to his base is still a mystery. Some evidence has been given to support the view that he possesses an apparatus which enables him, like a mariner, to make use of the earth's magnetic influence.

One of the great achievements of the last war was the invention of Radar, in which objects like aeroplanes reflect electromagnetic waves of short wave-length emitted from a home bases, back to the base. However, the principle of radar was known to the bat long before. The bat is blind but it emits squeaks and chirps as it flies. These are sounds of very high pitch and high pitch is the essential feature necessary to enable them to define with precision, by their reflection, the object which reflects them. And so, by this device, the bat detects objects in its path.

The use of smoke screens is common in modern naval warfare. However, the octopus invented it. It squirts into the face of its enemy a dark liquid something like India ink which it stores in a bag concealed within its body. Behind this smoke screen it can escape when threatened.

Incidentally, the octopus could claim a patent for another modern invention, jet propulsion. It can emit from a spacious cavity within its body a stream of water with high velocity. The reaction from this jet drives it as fast as an ordinary fish can swim and enables it to get out of the way quickly when it desires. Its forward motion is limited to a crawling one in which its flexible arms and suckers participate.

Modern warfare has exploited fully the potentialities of camouflage but these potentialities have been used from time immemorial, to a much greater perfection and in an enormous variety of ways by the animal kingdom. Everyone knows of the chameleon.

It is only comparatively recently that man has used invisible light, in particular, infrared, as a means to locate tanks in darkness when visible light is unsuitable or undesirable. However the cobra knows of this device. If you tape a cobra's eyes and swing a warm electric bulb in front of his head, he will strike at the warm object unerringly.

And among all of these complex mechanisms, perhaps, the most marvelous are those composed of ingenious devices, electrical, mechanical, acoustical, optical and chemical, which serve the needs of the human body.

Now with the aforesaid pictures as I have envisaged before us, what are we to surmise as to the meaning of it all ? In appraising the significance of the situation it is desirable to separate facts from dogma. We first raise the question : "Is the universe of intelligent design ?" I think that the answer of most of you will definitely be in the affirmative. The kind of ingenuity which is evident in the workings of the universe is, on a large scale, the work of the greatest engineering genius of all times, even though we have not attributed to him the responsibility for having created the basic laws of atomic physics on which everything depends. Success in utilizing those basic laws to the ends which we see around us would guarantee his reputation.

So far I have not implied the existence of an intelligent being in this matter. This would involve us in endless discussion of how the being came into existence. I must defer that question. I simply maintain that the evidence around us shows the same kind of ingenuity as that which we associate with the products of intelligence.

However, when I ask as to the origin of the fundamental laws of science, I face a different kind of intelligence, which transcends the calibre of any living being.

For no engineer has the task of inventing his own laws. His task is simply to exploit them. The greater intelligence had to formulate these laws and to foresee all the consequences. One of the most marvellous things is the fact that the ultimate formulation should be so simple. The man of science has always admired the process of the development of complexity out of ultimate simplicity.

One of the greatest examples of this kind of thing is to be found in Newton's discovery of the so-called law of gravitation. Before Newton's time, the motions of the heavenly bodies were a profound mystery. Kepler succeeded in reducing the description of the planetary motions to something which was the consequence of a few empirical laws. But Newton showed that these empirical laws of Kepler were themselves but the consequence of one simple law, the law of gravitation. From that law, everything else could be deduced, the motion of the planets, the times of occurrence of eclipses and a hundred other things. Even though one is not able to give a reason for gravitation, its assumption leads to many fruitful consequences. If I were facetiously minded, I would say that, while the function of a teacher is to take a complicated thing and make it seem simple, the function of a creator is to take a simple thing and make it complicated, so that in the complication, the richness of the universe may be achieved. But even Newton's law of gravitation is only a step in a single domain. There are the laws of electricity and magnetism, and many other laws, where simplicity in the formulation of the fundamentals has been achieved in several domains. The art of a creator, is to start with the fewest fundamentals and extract from them the richest consequences. In the laws of nuclear and atomic structure, we believe we have gone far towards finding those ultimate basic laws whose consequences are all we see around us. Undoubtedly much remains. The mystery of life has not yet been fitted into the picture ; but our experiences of the past give us ground for thinking that if simplicity appears not in the correlation of the laws of animate things with those of inanimate nature, the fault lies with us in not having found it. Sir J. C. Bose spent his life in correlating the responses of the living with the non-living.

Now, in the light of this picture, am I to believe in the existence of a so-called intelligent being, or am I to throw everything aside and say, "I will concern myself with the facts and not worry about how they came about ?" In the last analysis. I may maintain that everything came about by chance.

In order to appraise the significance of such attitudes, let me take an analogy. It does not involve the universe as a whole, but which really happened to me personally. It duplicates some of the essential features.

I visited ottawa in Canada in 1949. While returning home from the laboratory of N.R.C., a car came from behind, skidded on the snow-covered road and hit me. I fell unconscious. Incidentally I happened to be the only pedestrian and it was the only car on the road.

The driver of the car fled. While lying unconscious on the road, a tram-car came along. The driver looked at my plight, and telephoned to some place. After a little while a conveyance labeled "Ambulance" arrived. It carted me in an unconscious state to the Hospital. Somebody X-rayed my right leg and put me in a bed for a couple of days to recover from the shock. Then an orthopaedic surgeon came, operated my leg and put my leg in a plaster cast. I spent quite some time in the Hospital, and ultimately discharged as cured. Strangely enough, I had ensured my life against accidents only a week ago. And so, I had not to pay anything for my hospital expenses.

Now, if I am a complete materialist in this matter, I shall regard the uniformed driver of the street-car, who looked at me when I was on the ground and telephoned as playing no function in the case. The fact that he wore a uniform was incidental and, having looked at me, he possibly passed on his way without further thought. The arrival of the ambulance and the process of picking me up and putting me into it will have no relation to anything in particular. I might regard the stoppage of the ambulance at the hospital as due to the fact that the hospital is a centre of force with the characteristic that it attracts ambulances and repels other vehicles. When I get into the X-ray room, I must regard myself as just as a piece of material which happens to be there and gets X-rayed. I can go on in this vein until the whole history of my cure and discharge from the hospital is covered.

If somebody comes to me afterwards and says : "My friend, do you know how it came about that all this sequence happened ?" I shall probably say : "No, I don't, and I don't care." If my visitor explains that there is a government in Canada, which is a dominion of United Kingdom of Great Britain ruled by a Queen. It was her Governor-general in Canada, who set up a system of laws which were designed to cover all sorts of different circumstances, and that it was a consequence of these laws, through various complicated ramifications, the uniformed street-car driver who saw me on the ground and telephoned for an ambulance which took me to the hospital for the purpose of having me cured. If my visitor tells me all this, I may ask him for his criterion that such beings as he has envisaged in the total story actually exist; I shall ask him whether he ever saw the Queen of whom he spoke. He will tell me that the Queen lived in England, thousands of miles away and he had never seen her.

If I simply believe that the ambulance found me by accident and picked me up for no reason, I shall have very little hope that if I break my leg again another ambulance will come along just in time.

If, however, viewing what I may call the purposeful design around me regardless of the designer, I am willing to put some faith in the fundamentality of the design, regardless of the origin, I shall acquire a great sense of comfort in the belief that I am not alone, and that my future as well as my present, is somehow involved in the general design which seems to control the affairs of the country.

To return from my analogy of the country with its laws and government to the Universe and to my place in it, I would maintain I can probably make greater use of the richness and purposefulness of this universe if I recognize the existence of the Divine designer.

I think I should restrain myself from stepping into the domain of Theology which have been glorified by men like Gautam Buddha, Jesus Christ, Mohammad, Chaitanya, Ramakrishna Parambansa and others.

Before I conclude, I may perhaps tell you a short story.

Some years ago, I read an article entitled "Unforgettable Albert Einstein" by Banesh Hoffmann. He and Leopold Infeld collaborated with Einstein at Princeton. He recalled. "The intensity and depth of his concentration were fantastic. When battling a recalcitrant problem, he worried it as an animal worries its prey. Confronted with a seemingly insuperable difficult problem, he would stand up, put his pipe on the table and say in his quaint English, 'I will a little tink' (he could not pronounce "th"). Then he would pace up and down, twirling a lock of his long greying hair around his forefinger. A dreamy, faraway and yet inward look would come over his face. There was no appearance of concentration, no furrowing of the brow—only a placid inner communion. The minutes would pass, and then suddenly Einstein would stop pacing as his face relaxed into a gentle smile. He had found a solution to the problem. It was so simple and lucid. But the magic had been performed invisibly in the depths of Einstein's mind, by a process nobody could fathom." He once said "Ideas come from God". On the marble fireplace in the mathematics building at Princeton University is carved, in the original German, what one might call his scientific credo : "God is subtle, but he is not malicious." By this Einstein meant that scientists could expect to find their task difficult, but not hopeless. The Universe was a Universe of law, and

God was not confusing us with deliberate paradoxes and contradictions.

Finally, I wish to pay my respectful homage to the sacred memory of late Professor Meghnad Saha, one of the greatest sons of our Motherland. □

CALENDAR PROBLEM

M. L. CHAUDHURY*

A brief resume of the development of calendars is given and the defects of the current calendar are discussed. It is shown that the problem can be solved by amending the leap year rule in the way suggested here.

A calendar, as known, is a means for keeping track of time, particularly of the seasons that largely control man's life. An accurate calendar has been one of the oldest problems in astronomy and perhaps studies in astronomy itself at early stages were largely inspired by the need of a calendar for ecclesiastical purposes and for agriculture. At present it has become much more important for many complex needs of the modern society, such as, administration, statistics, communication, history and sciences. Although hundreds of calendars have been worked out and used[1] from the early days of all ancient civilizations a satisfactory solution to the problem has not yet been found.

In the early period calendars were developed along three lines : viz., purely solar, lunar and luni-solar calendars. Initial 365 day year in the Egyption solar calendar around 3000 B.C. in contrast to the 354-day year of luner calendars, was then amended to 365.25 days by Ptolemy Evergetes I (~238 B.C.) from the discovery of the sothic cycle of the observed helical rise of the sirius at the horizon.

The Hindus and Chinese have records of using the lunar and solar zodiacs about the same time. A leap year every fourth-year is also not new and was known early to the Babylonians, Egyptians and even to the Mayas of Mexico[2-4]. It is also of historical interest that a "continuous day-count" similar to the Julian day number devised by J. Schaliger (~ 1600 A.D.) and currently used in ephemeris, was introduced by Hindu astronomers before first century B.C. and their long count started from 17 February, 3102 B.C. reckoned by Aryabhata to be the beginning of the last of the four Yugas (era) comprising the current Meha-Yuga (cosmic era), as defined by the Siddhantas[5-7].

However, lunar affiliation had been so important an influence due to its spectacular cyclic phases and association with religious myths that solar calendar did not survive. On the other hand, lunar year being shorter than the tropical year by 11.2422 days and also differing from the actual twelve lunations by 0.3671 day, lunar calendars went completely out of step with the seasons, rendering it useless for dating the onsets of monsoon and winter, vital for ancient agriculture. Hence eventually almost all peoples changed over to luni-solar calendars—with the use of lunar months pegged to the solar year through various intercalations, such as, the insertion of a thirteenth month in three years introduced first by the Babylonian king Hamburabi (~1800 B.C.), the Octaeteris (three inter-calary months in a cycle of eight years), and more accurately, the metonic cycle with seven intercalations in a cycle of nineteen years, given by Meton (Athens, 430 B.C.). The Chinese are also known to have used this cycle around 1400 B.C. All these led to many hybrid calendars still used by different communities.

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The Julian calendar from which the current Gregorian Calendar has arisen is also a hybrid of solar year and lunar months and is a reform of the early Roman calendar and by 46 B.C. the latter fell behind the seasons by 90 days and Julius Caeser at the advice of astronomer Sossigenes decreed 46 B.C. (so-called year of confusion) to be a year of 445 days. Besides, Julius and his successor Augustine changed the names of the seventh month and eighth month respectively into July and August in their honour and allotted to each of them thirtyone days (even numbers were unlucky for the Romans). By 1582 A.D. an error of the ten days accumulated and Pope Gregory XIII dropped ten days from that year and introduced the current leap-year rule at the suggestion of the Vatican librarian, A. Giglio. This calendar known as Gregorian calendar was readily adopted by the catholics but even in England it was not adopted until 1752 A.D. and in many other countries, such as Russia, China; Greece etc. not until about 1920 A.D.

The current calendar

Although Gregorian calendar is now very widely used, there are many defects in this as summarized below :

(i) The Gregorian calendar is out of date being based on inaccurate data. The early calendars that evolved into this one, consisted in grouping apparent solar days in synodic months and approximate tropical year. With the progress of astronomy, it has become imperative to revise all these calendaric elements. Discovery of the uneven passage of the sun over the zodiac, inclination of the ecliptic and its variation, precession of equinoxes (a remarkable discovery by Hipparchus of Rhodes, ~200 B.C.) and periodic changes in the Earth's diurnal rotation due-to tidal and other perturbations and due to intrinsic movement of the poles etc.—necessitated correction in the apparent solar day for the purpose of Universal Time[8]. Hence a fictitious sun with an even sidereal motion on the celestial equator has been postulated and in terms of this day everaged over the past two hundred years or so, the tropical year has been computed by Newcomb[8-10] to be : $[365.24219879-6.14\times10^{-6}(t-1900)]\times$ mean days, t being christian year. While such extreme precision is aimed at in modern astronomy there is no justification to continue with the error in the current calendar.

(ii) Secondly, highly irrational part of this calendar is its lengths of months randomly varying from 28 to 31 days, having arisen from folk-lore, imperial decrees and superstitions of those dark ages.

(iii) Thirdly, the era adopted in this calendar is questioned by many researchers as the date of Lord Christ's birth is now seriously disputed[11-13]. Apart from this possible factual error in A.D., this being associated with one religion, could not be expected to have appealed to the sentiments of other religious communitics who are using their own traditional eras and their new years' days[14]. But for so closely interacting nations of the present day world, a universal calendar with a common ere is perhaps more desirable[15] now than ever before. It is therefore worthwhile to consider revival of the suggestion of great mathematician Laplace (as a member of the calendar Reform Committee of the French Revolution Government) that the rare astronomical event of 1250 A.D., when equinoctial line was perpendicular to the apse line be taken as the beginning of a universal era for a world-calendar.

(iv) The current leap-year rule is based on an inaccurate year-length as already mentioned. Though the error may seem to be small, importance of precision in data in science [cf. for example ref. (16)] needs no elaboration. The leap year rule is also cumbersome as it takes 366 days for those years (A.D.) divisible by 4 with the exception of the years divisible by 100, again with the exception of the years divisible by 400 to be reckoned as leap years and still leaving a remainder. The present leap-year rule also dislocates the usual calendar-schedule at short intervals every fourth year. There is therefore no justification for not rectifying its inaccuracies if possible.

(v) Most serious defect of the current calendar is that the days in a week, months and a year, as adopted in this calendar are not mutually commensurable. As a result week-days have no fixed link with the dates of months and drift randomly over the latter which also vary irregularly. Thus the beginnings of the months and years fall randomly on any week days. All these makes a shambles of the periodic events and holidays, causing serious dislocations in monthly working days in industries, offices and institutes and causes distractions in states' plannings, accountings and statistical comperisons—highly undesirable for inter-national business managements and administrations.

(vi) Furthermore, global wastages of money and labour due to this reason may well be understood from the fact that U.S.A. alone, according to one estimate [private communication from (17)] has an annual westage of approximately fifteen billion dollars by way of the cost of accounting operations only due to this basic fault in the Gregorian calendar with which the world is burdened.

(vii) None the less important is the fact that an accurate and perpetual calendar is essential in the interest of creating an ordered and harmonious pattern of life in place of the prevailing haphazard pattern in our work and recreations for which the current calendar is solely responsible.

Recent proposals of calendar-reform

Although the history of development of calendars is a record of repeated adjustments, serious attempts to put it on a rational basis, were made only during the past two hundred years or so as follows :

(i) French Republican Calendar (Sept. 1792-1806 A.D.) : The Gregorian calendar was first rejected by the French Revolution Government and a calendar Reform Committee was formed with great mathematicians Laplace, Lagrange and poet d' Eglantine as its members. One remarkable step taken by this committee was to reject 7-day week, which as shown below, is a product of superstition of the Chaldean astrology. Also the names of months being associated with myths were replaced by the names suggested by the poet member reflecting man's love for nature, for examples, Vandemaire (grape-gathering) in place of September, Nivossa (Snow) in place of December, Floreal (blossoms) in place of April, and so on. But adoption of ten-day week, introduction of extra-calendar days etc. were not practical and this calendar was abolished by Napoleon as a part of his bargain with the church for his coronation by the Pope.

(ii) Another proposal due to Padre A. Mastrofini (1834) is a calendar of thirteen equal months of 28 days each but fraught with some serious draw-backs particularly that of extra-calendar days.

(iii) Next was the proposal of French astronomer Armelin (1884 A.D.) of an unequal months but equal-quarter calendar that assigned 31, 30, 30 days respectively to January, February and March, and similarly for other quarters.

Since 1954 interest in both these calendars greatly diminished owing to various draw-backs involved. At present several national and international organization [for examples, references (17, 18)] are functioning for quite some time to devise a suitable reform but to the best of our knowledge, not much progress is reported. Nevertheless, there has been a general awareness in institutions, in many Government circles and also among the conscious of the public that an astronomically accurate and perpetual calendar is compelling. The demand for a change of the existing calendar has been so strong that recently Vatican's ecumenical council resolved not to oppose a suitable calendar in supersession of the Gregorian calendar and that the Protestent clergy also have its over-whelming majority in favour of the same resolution. It may also be recalled that even U.N. arranged a conference of its economic and social council in June, 1954 to consider reform of the current calendar in which late Prof. M. N. Saha was represented from India. But none of the proposals were found acceptable. We give below our suggestion.

A new leap-year rule and perpetual calendar

It is evident from above that the main defect of the current calendar is that 7-day week is not commensurable with months and year. So there can be two alternatives to rectify it, viz., (i) either, 7-day week is retained and lengths of months and year both changed to obtain, if possible, a perpetual calendar, or (ii) we reject 7-day week and choose reasonable periods for week, months and year, so that these are mutually divisible. In both 13-month calendar and Armelin's calendar, in order to retain 7-day week, the lengths of both months and year were changed and went so far as to introduce extra-calendar days which would have no week-day denomination, no dates of months, would break sequence of week-days thus create a vacuum in the calendar. As already mentioned, such a course has already been rejected in the U. N. Conference. So it can perhaps be safely concluded that if 7-day week is retained no satisfactory solution to the problem is possible. Then only alternative seems to be the aforesaid course, (ii) i.e. to replace the 7-day week by a suitable period. Before giving our plan, we examine week, month and year for calendar purpose.

(a) *Week :* It should be emphasized that 7-day week is not a natural period and was initially unknown. The idea of a week originated from pre-historic usage of fixing market-days, and various periods, viz., 4-day, 5-day, 8-day and even 10-day weeks are recorded to have been used by different peoples. So historically, 7-day week has no preferred basis compared to others. Again 7-day week is nothing sacrosanct, rather has its origin in the superstition of the Chaldean astrologers, who around 300 B.C. hit upon the idea that number 7 has sanctity being equal to the number of planets (within their knowledge) and their planetary deities. In this age of science, no one believes in such a hebdomadal philosophy. Because, if Mercury, moon, Mars, Jupiter, Saturn etc. are demi-gods, then why Uranus, Neptune Pluto and their satellites are not so ? Again, according to astrology, the rank of these deities was taken in the supposed order of their increasing distances from the earth and hence in decreasing order as Saturn, Jupiter, Mars, Sun, Venus, Mercury and Moon. It may be seen that Mars was taken more distant from the earth than the sun which is grossly wrong, and even a staunch astrologer would find it impossible to believe the above order. Then the myth of the present sequence of week-days is also false. Because, this sequence was established by the Chaldean astrologers (and perpetuated till this day) taking Saturn as the ruler of the first hour of saturday and then assigning the control of each successive hours in turn to other deities in the aforesaid decreasing rank of the deities. Thus the 25th hour i.e. the first hour of the next day comes under the rule of the sun. Since a day was named after the deity ruling the first hour of that day, so Sunday follows Saturday and similarly for the other week-days. Besides, it is known that the Egyptians divided day (including night) into twentyfour hours and it is fantastic to think that all astrological deities (if any) by mutual consent and in obeisance to the Egyptians, divided among themselves twentyfour hours of each day for their hourly watch on human fate and activities. Also 7-day week was unknown to the writer of the new Testament or to the writer of the Geeta. Therefore, 7-day week has no logical basis and has nothing to do with any religion. If we want a satisfactory perpetual calendar, of which the world is in dire need, 7-day week has to be abandoned.

Hence we propose a six-day week calendar and since Sunday has acquired a sense of holiday, we propose to drop saturday instead of some intermediate day of the week.

(*b*) *Month and year* : Since there is no justification to take varying lengths of months and 30 days being nearest to average solar month of 30.4368 d, and divisible by 6-day week, we take for our calendar 30 days each for January to November and remaining days of the year are to be assigned to December. Next question is what should be the appropriate length of year. We propose to take 366 days (divisible by 6) for our calendary-year. It is needless to say that there is nothing unusual in this as we are already having it every fourth year, and nobody even takes notice of it. It may also be seen that 366-day year would be rather closer to the tropical year than 364 days in the other (the 13 month and equal quarter calendar) proposals and 354 days in lunar calendar, which were rejected in U. N. not for deviation from the tropical year but for other reasons. So in our proposed calendar, each month January to November, will contain 30 days (grouped in five weeks of six days each) and the remaining 36 days to be assigned to December which then will be longer than the current December by five days. These additional days in our proposal, are not to be treated as extra-calendar days but will be dated as 32nd to 36 December. At present in almost all countries the last week of December and a part of the first week of January are either observed as holidays or availed of as leave. It will therefore not matter if January is apparently shifted by five days and these additional days of December be treated as year-end holi-days. The shift is only apparent because in our proposal two days are restored to February and remaining additional days instead of being scattered randomly over the months, as in the current calendar, are collected at the last month. Great advantage of this proposal is that days of the week will have a fixed link with the dates of months for all years provided the current leap-year rule is amended as suggested below.

(c) ***A new leap-year rule* : '*Leap-back a week*' and '*Oscillatory compensation*'** : Since our calendar-year of 366 days is slightly longer than the tropical year, we require an appropriate 'Leap-back' rule instead of the current "Leap-a-day forward" rule in the Gregorian calendar. It would also be evident that if the link between week-days and dates of months, is not to be disturbed, the suggested "Leap-back" should be by a quantum of one full week of six days. Now, in eight years our calendar will be ahead of the tropical year by $(366.00-365.24219879) \times 8$ d $= 6.0624097$ days. So if we treat every eight year as a "Leap-back year" (hereafter referred to as LB year) when all months including December, will have 30 days each, then accumulated advancement of the calendar over a eight year period, will be compensated for (leaving a small margin) and thus the link between the days of week and the dates of months will remain undisturbed for all years.

However, this calendar, as mentioned, will be ahead in every eight years cycle by a small margin of 0 062141 day. So a long period correction is required, as is also applied in the current calendar, but in our plan in a much simpler way. The current leap-year rule is inaccurate and cumbersome as mentioned earlier. In our proposal, in 800 years i.e. after 100 LB years, new calendar will be ahead of the tropical year by 6.241 days which can be compensated for, by taking an additional LB year in the 801 st year or preferably at the initial 401 st year in pursuance of "Oscillatory compensation" method suggested below. However, the remaining 0.241 d per 800 years, will accumulate in 25 such cycles (i.e. in 20000 years) to another week (6.025 d) which correction we can safely leave to our posterity.

(*d*) *Oscillatory Compensation* : To be ahead by six days in 800 years is perhaps immaterial if corrected at the end of the cycle. But to be ahead of tropical year by six days over a period of eight years may not be desirable even though we would be holding the great runner by the forelock. To reduce this deviation we propose an initial compensatory leap-back as follows: supposing the new calendar be adopted in 1985 A.D. Then in the fourth year i.e. in 1988 A.D., this calendar will be ahead of the tropical year by 3 days (leaving the small margin of 0 0312048 d (cf. paragraph (c)) to be taken into account over the said long cycle). So if 1988 A.D. is taken as a LB year of 360 days, then in the beginning of 1989 A.D., the calendar is over-compensated and would be behind the tropical year by 3 days. This lag will be made up annually by about 0.75 day and the year 1992 A.D., though of 366 days will be a neutral year. By 1996 A.D. the calendar will again be ahead of the neutral year by 3 days and so that year is to be taken as a LB year. The process will be repeated with 2000 A.D. becoming the next neutral year and 2004 A.D., the next LB year and so on. Thus with the suggested initial compensatory leap-back, the calendar will oscillate about the neutral year with an amplitude of ±3.0 days for the extreme years, and with ±2.25, ±1.5 and ±0.75 day variations for the intermediate couples of years. This we have reffered to as the oscillatory compensation.

Economic and Social aspects of the new calendar

It may be seen that according to this calendar and on daily rate basis, an employee's six days' pay will accumulate by 30th December and they will get proportionately higher pay for the long month December; while an employee's monthly pay will reduce only by a small amount. Thereby, states and organizations will have huge savings (from deferred payments) for investments over one year and similarly for every year. This should help the economy. Besides, one would have a rest period recurring at a short interval of 5 days or 4.1/2 days (if Friday or Monday is treated as half-working days) which would be in the interest of efficiency of the workers and being claimed by industrial workers. Thirdly, printing of new calendars every year entail huge unproductive expenses and global wastage of money which would be unnecessary.

Religious and social observance: It is important to note in this connection that Vatican's Council recently adopted a resolution by overwhelming majority to have a fixed date for Easter in place of the age-old tradition of its verying dates. If this is possible for an important ceremony like Easter, then there should not be any objection to link other ceremonies with dates of months instead of days of week. It would therefore appear that a little adjustment can solve the question of adapting religious and social observances to the new calendar.

It may be apprehended that the six day week plan wauld be against the present convention of seven day week used in the current calendar. But it is needless to mention that an astronomical problem or any work in Science should be viewed objectively and the underlying scientific principle should get precedence over convention. Science has now come to a stage where subversion of science by convention (religious or otherwise) as happened in older days, is a thing of the past. Besides, the convention of seven day week originated as already said in superstition and was legalised by Roman Emperor in 3rd century A.D. One would naturally ask what was the convention over thousands of years in Vedic and Budhist periods in India preceding the said 300 A.D. There are reasons to believe that six day week was in vogue in India along with the pakshas. Seven day week being not commensurable with natural periods of month and year all attempts to work out on this basis a perpetual satisfactory calendar have failed, whereas the six day week plan smoothly leads to an exact solution to the problem of calendar, which as known causes so much socio-economic problems to the whole world.

A second point that may be raised is that the six-day week plan may be interfering with the sabbatic cycle of the Jews and the Christians. It may be emphasized in this connection that the Sabbatic cycle and the seven day week are mere coincidence and not synonymous because these originated from entirely different ideas and also at different periods of history. The seven day week was introduced by Chaldean astrologers on an erroneous idea that number seven has sanctity being equal to the number of planets (within their knowledge) and their planetary deities whereas Sabbath originated from the religious belief that starting from a day of reference, the seventh day is reckoned as the day of rest for the Christian God or for the Jewish God Jehova, after six days' labour of creation. Needless to mention that the start of creation and the first Sabbath for Christian or Jewish God was far antecedent to the origin of the hebdomadal philosophy of the Chaldean astrologers.

So, that the Sabbatic cycle has a period of seven days, is irrespective of the definition of a week. Week has been defined variously at different times by different peoples. There have been 4 day, 5 day, 8 day and even 10 day weeks (c f. Encyclopedia Britannica). Evidently that the periods of Sabbatic cycle and seven day week are equal, is a coincidence and not synonymous and hence not inseparable. Furthermore, it is shown above that the present sequence of week days is based on a gross astronomical error and the myth is false. Therefore the six day week plan should not be misconstrued as interfering with the Sabbatic cycle. As said, the Christians have already relaxed their attitude and an important ceremony like Easter has now been linked with the date of the relevant month instead of the day of week. Mohammedans observe Id, Muharrum and other ceremonies linked to the dates of months instead of days of week. Diwali, Pujas, Holi, ekadashis etc. are observed by the Hindus irrespective of days of weeks, and these are linked to dates of months. Therefore there is no reason why the Sabbath days can not be linked to the dates of months instead of days of week. For example let us suppose that during the change over to the new six day week calendar, the last day of Gregorian calendar be a Saturday which is the Sabbath for the Jews. Then the first day of the starting month (and any month) in the new calendar, if taken to be a Sunday, the 1st, 8th, 15th, 22nd, 29th dates of the starting month and then 6th, 13th, 20th, 27th, etc. dates of the next month and so on, would be the Sabbath days for the Christians. Similarly preceding days being the Sabbath for the Jews, they would have—7th, 14th, 21st, 28th dates of the starting month and then 5th, 12th, 19th etc. dates and so on for other months as their Sabbath days and these dates may be red figured or marked as such in the new calendar. This cycle of the Sabbath days will recur after every four months.

At present the World is bicalendric. All communities except the Christians and the Jews, have the seven day week calendar only for their Govt. purposes and follow their respective community calendars for religious and social observances (e.g. The Hindus having their Panchangs, the Mohammedans their Hegira). If the calendar is rationalised on the scientific principle as presented in this paper all communities will have a perpetual calendar for Govt. and other purposes and may adapt their religious ceremonies to the dates of the new calendar and the evils of current calendar will be eliminated.

Alternative proposals

By applying the "leap-a-week" rule suggested here, some improvement in 7-day week calendar, may be made.

In spite of this improvement, this modified 7-day week calendar would be perpetual and would be far inferior to the proposed 6-day week calendar.

Table 1 (See next Page) shows the six-day week calendar plan given in earlier.

Of course, with the consensus of all concerned, the first day of a week and a month (and hence every month) may be taken as Monday and ending on Sunday.

To summarize, (i) Since December is the last month and its last week is almost universally availed of as holidays or leave, additional five days in thirtysix-day December month in the new calendar, may be treated

TABLE 1

January to November						December					
S	M	T	W	Th	F	S	M	T	W	Th	F
1	2	3	4	5	6	1	2	3	4	5	6
7	8	9	10	11	12	7	8	9	10	11	12
13	14	15	16	17	18	13	14	15	16	17	18
19	20	21	22	23	24	19	20	21	22	23	24
25	26	27	28	29	30	25	26	27	28	29	30
						*31	32	33	34	35	36*

* The dates December 31st to 36th are to be omitted in LB years

as year-end holidays and should not be inconvenient, (ii) Savings of states from deferred payments mentioned above will be an important boost to economy and yearly printing of calendars would be unnecessary and save huge global wastages of money, (iii) Greatest advantage of this calendar is that it will have fixed link between week days and the dates of months. Thus if the first day of January is taken as Sunday, then all other months including December, will each begin on Sunday and end of Friday (provided Saturday is dropped as suggested) and new year will again begin on Sunday. This will bring harmony in our work and recreation, regularity in monthly working days, facilitate states' plannings and save labour and enormous wastages of money incurred in accounting operations, (iv) Besides LB year will recur every eight year and hence unlike the current calendar, calendar schedule will remain undisturbed for a longer period.

Table 1 shows remarkable simplicity of the 6-day week calendar scheme compared to the current calendar.

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A DAY WITH PROFESSOR M. N. SAHA*

MRINAL KUMAR DAS GUPTA**

IT was in the summer of 1954 that I had the proud privilege of spending a day with Professor M. N. Saha in Manchester. One fine morning I received a letter from my friend Dr. Sunil Kr. Sen, who was then in Liverpool, telling me that Professor Saha will be visiting the Jodrell Bank Experimental Station of the University of Manchester on his way back home from Geneva where he went to attend a Conference. I was extremely delighted for two reasons. Firstly, because an Indian Professor will be an honoured guest in the laboratory where I was working and secondly, because I shall have this opportunity of meeting him for the first time.

I still remember the day. At about 6 A.M. in the morning when I was still in bed, my landlady shouted telling me that I had a phone call from the Manchester Central Station. I hurried downstairs and was glad to find that it was Sunil at the other end. He told me that he was accompanying Professor Saha and they had just arrived in Manchester. For a moment I was rather hesitant about what to do in this early hour of the morning. But that was unnecessary since Professor Saha himself suggested that they would come to my place for breakfast. My landlady was of course very glad to know that a great Indian Professor would be coming to her place.

I went out to receive Professor Saha at the Bus Stand, a few minutes walk from my place. "I understand from Sunil that you will soon be going back to Calcutta. Have you got any suitable job yet ? If not, then why are you going back ? Don't you know how difficult it is to get a good job there ?"—That was his first talk with me. He continued, "Try to get a Lectureship in the Manchester University, which you may easily get, then it will be easier for you to get a good start in any of the Indian Universities". In reply I told Professor Saha that as it was more than three and half years that I left home, I was rather home-sick. Anyway there ended the particular topic. Later, on my return here I realised what a fool I was not to stick to his advice since I had to spend a few months without any employment.

Professor Saha thoroughly enjoyed the breakfast so carefully prepared for him by my landlady. He was particularly pleased to have a very nice cup of tea. I rang Dr. R. C. Jennison, one of my colleagues at the Manchester University about the Professor's arrival, as he was to pick us up in his car for Jodrell Bank which is about 25 miles from Manchester. Jennison told me that he would come to my place in about an hour's time. As I came back I found that Professor Saha was reading something with deep concentration. I was rather surprised to find that he was reading the report of a recent conference on Radio Astronomy. He discussed several points with me and smilingly remarked, "I must clarify some of my ideas so as to make my visit to the largest Radio Astronomical Laboratory quite interesting and instructive". Needless to say, he was well conversant with the basic principles of the new science of Radio Astronomy. One characteristic of Professor Saha as I noticed was that he could never sit idle ; he would either read some reports of some conferences or read some reprints of some research papers. While reading, he always used to underline the salient points and also used to write his personal comments, criticisms or notes by the sides.

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* The article was first published in the 'Physics Alumni Annual—1957', University of Calcutta. It has been referred to in a book entitled, 'Astronomy Transformed' by David O. Edge and Michae J. Mulkay published by John Wiley & Sons, 1976. It is rather interesting to find that the article published in a not too well circulated magazine could somehow attract the notice of some interested persons elsewhere after twenty years. It is hoped that the reprint of the same in the 'Science & Culture' will give an opportunity for the younger generation to have some glimpses on the dynamic personality of Professor M. N. Saha, one of the greatest scientists of all times.

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We started for Jodrell Bank at about 8 A.M. Professor Saha was sitting by the side of Dr. Jennison who was driving, Sunil and myself occupied the back seats. All along the route Professor was very often turning back to talk to us in Bengali particularly regarding the present conditions in India in various spheres. At one time Sunil told him very politely to talk in English as otherwise, as an Englishman, Dr. Jennison might be offended. At this Professor Saha emphatically remarked, "Why should I disclose all these unsavoury things of our country to a foreigner ?"

We reached Jodrell Bank at about 9 A.M. Professor A. C. B. Lovell, Director of the Experimental Station was not present on that day. Professor Saha was, however, very cordially received on his behalf by Mr. Hanbury-Brown, Dr. T.R. Kaiser and others. The very sight of the Jodrell Bank Experimental Station with its colossal Radio Telescopes, gigantic aerial arrays and the nice layout of the experimental huts in the midst of a lovely countryside in Cheshire impressed him very much. His first remark was, "I wonder when we shall be able to see such a laboratory to flourish in India."

Just stepping inside the main laboratory Professor Saha whispered to me enquiring whether I could fetch him a hot cup of tea. While he was having his cup of tea, the activities of the laboratory were being explained to him by Drs. T. R. Kaiser and J. G. Davies. Apparently he took a keen interest in the new subject of Radio Astronomy and was asking them questions every now and then. He was then taken around the various laboratories, ten in number, where about twenty different research works were being undertaken. He seemed to be particularly interested in the Solar Radio Noise and the 21-cm *line* radiation (from interstellar neutral hydrogen atom) projects and spend much of his time in those two laboratories. All our colleagues were very pleased to meet Professor Saha and to explain to him about their own researches. Almost all of them have heard so much about Professors M. N. Saha, S. K. Mitra and S. N. Bose of Calcutta. Incidentally, I may mention here that at first, I was very surprised to find that most of our colleagues were under the wrong impression that Professor S. N. Bose is a German, most probably because of the 'Bose-Einstein' coupling ! I was very proud to disclose to them for the first time about Professor Bose's true nationality.

After spending about four hours in the various laboratories we went to lunch in the Canteen of the Experimental Station. Professor Saha was given a middle seat so that all the members of the staff could have an opportunity of distinctly listening to his conversations. He was very much interested to know in detail about the canteen management and the facilities derived from it by the members of the staff. He suddenly turned to me and smilingly remarked in Bengali, "Our Institute of Nuclear Physics has now a canteen of its own, although very small in comparison to this one. Anyway, we have started one !"

After the lunch Professor Saha was taken to the site in an adjoining field where the colossal steerable Radio Telescope of a diameter of 250 feet, first of its kind in the whole world was being constructed. A model of this Radio Telescope, only two feet in diameter was first shown to him. The concrete foundation of this massive structure of steel was just being completed and two huge cranes were being installed for the purpose of ultimate construction. Incidentally, it may be mentioned here that the construction has now been completed only a few months back. Professor Saha was highly impressed at the structural engineering feats of this gigantic Radio Telescope and wished its rapid progress. While coming back from the site he got hold of a full size brick from a stack, threw it on a piece of stone nearby so as to break it. He took one broken piece showed it to us and remarked in Bengali, "Look at this brick,—what a marvellous stuff ! In our country, even a brick won't be free from pollution of unnecessary elements ! It takes a country long time to flourish as a great nation".

After having tea Professor Saha thanked the authorities and the research staff for the kindness shown to him during his visit to the Jodrell Bank Experimental Station. He was presented with a vast number of reprints of the research papers published from that big laboratory. We came back to Manchester at about 4 P.M., while in Manchester proper Professor Saha asked me if I could take him to the 'Manchester Guardian' Office. He wanted to purchase if possible, a booklet on "Greek Archaeology", published by them a few years back. We went there but unfortunately could not get a copy of the said booklet. A scholar of varied interest, he was found to be extremely disappointed in not being able to procure this booklet.

The next train to Liverpool was at 6 P.M. and we thus had barely two hours more in hand as Professor Saha was to go to Liverpool with Sunil the same evening. "What to do now", he asked me. I suggested whether he would like to have a quick visit to the Radio and Electronics Exhibition being held at that time under the joint auspices of the British Institution of Radio Engineers and the British Association of Radio Manufacturers in the premises of the Manchester College of Technology. Professor Saha was very much delighted to know of such an exhibition and we spent about an hour and a half going round the exhibition. He took a keen interest on the various exhibits and asked Sunil to take notes of the equipments which were new and might be necessary for our laboratories in Calcutta.

From the exhibition we went straight to the Manchester Central Station. There was yet some time for the departure of the train. At the suggestion of Professor Saha we had tea from one of the mobile tea stalls on the platform. Professor then asked me if I could possibly accompany him to Liverpool so that he might have some relaxation in talking with us leisurely on various topics. I was indeed very sorry not to be able to avail this opportunity as I had a previous engagement for the next morning. The train came in time. We could easily find a good seat for him. I was standing on the platform by the side of the compartment where our Professor was sitting. He talked to me till the last whistle of the train. The train puffed off. I came back to my place with a thoughtful but pleasant mood. That was indeed one of the memorable days of my life when I came in contact with Professor M. N. Saha for the first time.

During this short period of barely twelve hours, all the time I deeply felt that I was in the company of a dynamic personality—a personality of great wisdom coupled with superb action. Professor Saha had a wide range of vision,—a vision both microscopic and macroscopic. He could see clearly deep into any problem and could foresee things distinctly quite ahead of others. All through the day he talked with us almost about everything—scientific research, national problems, our present Government, our present society, refugee problem and what not ! It appeared to me that he did not hesitate to criticise anybody for a just cause. He was quite aware, about the handicaps to the progress of scientific and industrial research in India. All of us know, how devotedly he struggled all through his life for the betterment of the situation. Whenever he talked about our national drawbacks and slow progress, I found him to be mentally disturbed and visibly moved. One of his characteristics, whenever he went to visit any foreign laboratory or institution was to give a serious thought of introducing new researches, new institutions or associations on similar lines in India. On his return home, he left no stone unturned till the fulfilment of his desire. Professor Saha's name will no doubt be written in gold in the history of scientific research in India as an originator of so many institutions, associations and schools of research in India. During this last tour in England, he was deeply concerned with the future possibilities of the development of a Radio Astronomical laboratory in India. In the fitness of things it has really been very wise on the part of the organisers of the 'Saha Memorial Committee to adopt the unanimous decision of setting up of a Radio Astronomical Laboratory to be named after him. Let us hope that by our co-ordinated effort we shall be able to perpetuate the memory of this great man in a befitting manner.

May his spirit and lofty ideals rest with us and guide us and may his soul rest in peace ! □

NOTES & NEWS

Aquaculture

Aquaculture, i.e. the farming of aquatic plants, can be a significant source of food for India, according to S. Z. Qasim, Department of Oceanography, Government of India.

There is a vast scope for using the backwaters and estuaries adjoining the coasts of India for such farming. About five million tons of food are at present produced in the world by aquaculture from approximately 400,000 hectares of cultivated aquatic areas. In India, it is reckoned that herbivores or plankton feeders are most suitable for aquaculture because their harvest in terms of surface area or volume of water, their use of raw materials such as energy and their natural or artificial fertility are greater than those of carnivores.

The culture of milk fish has been found rewarding in the country, though yields are not as high as in Taiwan. Mullet culture is also important, as is that of eel. Shrimp culture has possibilities as certain parts of the country have shown. So far, the country has achieved its maximum success in the culture of molluscs. Mussel culture on ropes has had spectacular results. Also, the culture of clams, edible oysters and window-pane oysters has been undertaken successfully.

Treated sewage could be utilised to produce fish and the wastes from industrial complexes like fertiliser factories could be used to cultivate several edible types of aquatic animals. □

The Statesman

Mother nature effectively treats

Spending a few hours and getting a bronze suntan along the stark shores of the Dead sea is now called "heliotherapy". And taking a refreshing dip in the sea's bouyant waters is classified as a "balneological treatment". Many people enjoying the Dead Sea sun and water these days are in reality patients checking into these popular medical programmes to treat serious deseases. Rather than girdling themselves for sterile hospital beds, bland food and endless hours of boredom, they are encouraged to pack up their dancing shoes, swim suits and tennis rackets. These patients are undergoing Israel's climatotherapy programme—a healing regime where Mother Nature is the chief physician.

Like many other projects in Israel, climatotherapy is an "old-new" concept. Two thousand years ago, the Jewish historian Josephus Flavius wrote "...one should praise the Dead Sea...this salt brings healing to the human body and therefore is mixed into many drugs...". More recently, however, Israeli scientists have been investigating precisely why the Dead Sea region has long been considered as a most salubrious environment.

Their findings have been amazing and have paved a way to an entirely new industry by the use of the climate at the lowest place on earth as a vast natural pharmacy.

Many people are familiar with traditional health resorts, such as that prescribed by Thomas Mann in The Magic Mountain. Patients flocked there because the thin alpine air and plenty of rest were thought congenial to their health. Israeli medical experts cast their longing-lingering look at the opposite direction—down to the Dead Sea, where the air is denser than anywhere else on this planet.

This means that the patient takes in 10% more oxygen in each breath. The thick blanket of air overhead serves as a protective screen against the ultra-violet-beta (UVB) rays —the kind which causes sunburn—while he or she can fully benefit from the UVB rays—the kind which causes suntan.

According to a scientific study conducted by Jonathan Kattan-Byron and David J. Abels, both physicians at the Soroka Medical Center in Beer Sheva and the Israel Health Resorts Authority, "the air at the Dead Sea area is among the purest in the world, and because of the absence of pollution (industry, traffic, vegetation), it is ideal for the relief of respiratory allergics".

The water is as beneficial as the air. The exceedingly high salt concentrations (ten times that of the ocean) indicates that no micro-organisms can exist—hence the apellation Dead Sea. This also shows that there is no danger from coming into contact with bacteria and fungi which are harmful to health. Also, the very dense concentrations of other minerals in the sea have definite therapeutic benefits. For example, magnesium is a common ingredient in many skin ointments and is remarkable for its ability to soften and cleanse skin. Bromine, in the air and water, is recognised for its relaxing action on the nervous system.

The high concentration of minerals also makes the Dead sea waters very dense so that swimmers float effortlessly. Physicians exploit this phenomenon as a means of treatment for patients with rheumatism and those suffering from muscular and joint diseases as well as people recovering from various froms of paralysis. One of the big boons to medicine has been the treatment of psoriasis and other skin diseases at the Dead Sea.

The psoriasis treatment is essentially little more than a vacation by the Dead Sea. It lasts 2-4 weeks and involves sunbathing and swimming for prescribed periods every day. Simple preparations such as petroleum jelly, are used to begin softening the problematic skin areas. Patients are examined daily by a medical doctor and nothing artificial—from drugs to sunlamps—is administered. The patients have ample opportunity to dine properly, socialise, dance or engage in sports. Indeed, the attending physicians believe that such activities shared by patients with similar problems provide a psychological stimulus to recovery.

Medical insurance organisations in West Germany, Holland and Denmark have recognised the medicinal benefits of the Dead Sea climatotherapy ; they cover their subscribers' expenses during their stay at the Dead Sea. In the United States, the matter is currently probed by Blue Cross and Blue Shield ☐

News from Israel

Solar energy for California

Southern Californians will soon be using power drawn from their famous sunshine using Israeli technology. Electricity will be produced at the biggest power station in the world based on the principle of the solar pond. The facility is being built in San Bernadino Country as a result of $ 15 million agreement between the Southern California Edison Company and Ormat Turbines of Yowne (Israel), the leading developer of solar ponds and low-temperature generators. Power generated from the California solar project is expected to cost 10 cents/Kw/hr ; the cost is several cents more than conventional thermal plants, but production of solar power will reduce reliance on traditional source to meet peak demands. In the first phase, the plant will have a 12-MW capacity. By the end of 1987, there will be 48 MW—enough to meet the peak-power demands of 30,000 Edison customers.

The principles by which the solar pond works are quite simple. Sun shining on a normal body of water penetrates and warms the water to a depth of 1 m. This deeper warmer water expands and rises to the surfaces, giving up its heat to the atmosphere. In the solar pond, however, the bottom layer is saline and unable to rise, so that the thermal energy is simply absorbed there and the salty water continues to get hotter and hotter as the sunshines. One of the problems Israeli scientists had to solve was how to maintain the salinity gradient over prolonged periods of time and how to prevent wind and waves on the surface from mixing the layers of salinity. Next, they faced the dilemma of extracting the heat from the pond depths.

The temperature at the bottom layer of the pond reaches 80-90°C, which is too low to be used by conventional steam-powered turbines. Ormat engineers, however, developed a special low-temperature turbine from the hot-water of the pond depths. At solar ponds in Israel, sun-heated salty water from the bottoms of a 52 acre pool and a 40-acre pool is pumped but and used to heat a special organic fluid with a low-boiling point in turbine. The vaporised fluid then turns the blades of a generator, which produces electricity.

In the fifties, Israelis built the first experimental solar pond in the Dead Sea region, the lowest and also one of the sunniest points on earth under the direction of Harry Zvi Tabor, the pioneer of solar energy, together with Ormat President Yehuda Bronicki. Although the men demonstrated the practical validity of the concept, the idea was not developed at that time due to cheap oil supplies. In 1974, the concept was revived with a new pond at Ein Bokek—built with the Israeli government shouldering 75% of $ 20 million bill.

The latest solar pond was recently completed in Kalia at the northern end of the Dead Sea. This pond is 60 acres in size and will produce 5,000 KW of power. The larger new California plant will be modelled on these plants, producing 48 MW of solar-pond power. Though the facility is to be built and operated by a subsidiary of Ormat Ltd., Southern California Edison has agreed to buy the electricity generated there for a period of 30 years. ☐

News from Israel

An eye opener

An ingenius state-of-the-art gadget which sounds an alarm when a person falls asleep while driving, working at night or doing guard duty has been developed by a high-tech Israeli company called Xanadu Ltd.

The optronic device, 16 gm in weight and attached easily to eyeglass frames, is operated by batteries lasting 700 hr. The batteries power a sensor which can tell, them when the eyelids are closed longer than 4/10 sec. So when you involuntarily begin to steal some shut-eye, a tiny alarm pleasantly brings you back on to the job.

The device, already in use in the Israeli army, is called "Onguard" and patents are pending. ☐

News from Israel

New road-building method

Co-operation between Technion (Israel Institute of Technology, Haifa) researchers and Moduleway Ltd., a Tel Aviv-based firm, has resulted in a new road-building method that will reduce costs by about 30%. In contrast to conventional roads built solely from asphalt, the newly-developed road is composed of three layers : a layer of concrete, a second layer of granular material (usually sand) and a third layer of concrete. The materials are cheaper than asphalt and the quality of the road is significantly improved.

The concrete roads have been tested

successfully over the past three years in Texas and the Golan Heights in Israel and prove to be far more durable and sturdy than asphalt roads.

The new method has many advantages over conventional methods. Significant cost reductions in building the roads can be achieved because of the utilisation of sand. The concrete road is able to endure bad weather conditions ; the over-all life of the concrete road is 15 years and asphalt roads last not more than 5-7 years. Additionally, the maintenance costs of concrete roads are far lower than those of asphalt roads. Another benefit is that a vehicle can drive on the road a few hours after it is built. The road does not require any hardening additives because the concrete pulls the water from the wet sand, accelerating the hardening process. Less work is demanded in building the roads because its infrastructure does not have to be smooth. Furthermore, due to the use of sand, the distance between the expansion joints can be five times greater than in asphalt roads, resulting in further savings. ☐

News from Israel

Seminar on 'Taj Mahal'

A seminar on Taj Mahal was organised by the Central Building Research Institute, Roorkee on Sept. 3, 1984 to consolidate the information and ideas on the work produced in Roorkee on this monument. Presiding over the seminar Dr. M. S. Nagaraja Rao, Director General, Archaeological Survey of India, said that the Taj has been a symbol of our national and emotional integration and hence it was imperative to keep it in excellent conditions for our posterity. He pointed out that Union Government was deeply concerned about its preservation and had, therefore, appointed a High Powered Committee having four Sub-Committees of experts to look into various aspects of its preservation.

The following four papers were presented in the seminar which was attended by about 250 engineers, architects, scientists, military officers, professors, students and press reporters.

(i) Taj Mahal—Its Historical and Engineering Aspects by Dr. S. C. Handa.
(ii) Architectural and Town Planning Aspects of the Taj by Sri B. B. Garg.
(iii) Environmental Aspects of the Taj by Dr. Mohd. Aslam.
(iv) Studies on the Durability and Preservation of Makrana Marble Stones by Dr. G. S. Mehrotra.

Summing up the proceedings of the seminar Prof. Shamsher Prakash, Director, CBRI, said that it was essential to look into the preservation of the Taj and other national monuments from all angles viz. structural safety of the building and foundations; architectural and planning ; environmental pollution ; development of biomass in between crevices and restoration of the monument.

The seminar resolved that a national seminar be held in the near future to discuss in totality the problems associated with the preservation of the Taj and other national monuments.

The proceedings of the seminar containing four papers and the opening and closing speeches can be had from the Director, CBRI, Roorkee for Rs. 20 including postage (Post paid). ☐

VIII. TRADE AND COMMERCE

TRADE AND COMMERCE : AN ASPECT OF CIVILISATION

(Key-note Address)

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TRADE and Commerce are the off-shoots of modern civilisation. Primitive man's wants were few ; he did not need either an aircraft or an automobile to meet his transportation needs nor could he desire to have a train journey for the purpose. He could not even conceive of a bullock cart. He was not desiring a television set, tape recorder or a radio to while away his time in relaxation. His wants were few ; he needed only a shelter which was provided by Nature by way of a cave and some food which he initially obtained from nature and, thereafter, through hunting wild animals with the means of primitive armour. He was a nomad and did not require parmanent place to stay, since he was moving all the time. He ate only when he could kill an animal but did not have the facility to store his foods either. He was bare-bodied and he accepted the vagaries of Nature. His needs were minimum and since his living was on a day-to-day basis the question of trade and commerce was non-existent.

With the passage of time, he learnt the art of agriculture to supplement his food habits. This development compelled him to give up his nomadic habit and stay near the place of cultivation. He gradually learnt the art of domesticating wild animals for the purpose of agriculture and also as a source of food. The domestication of horse gave him mobility and he also learnt to grow cotton and prepare his clothes from cotton threads. Properties were of community-basis and shared according to the needs.

In course of time, they were faced with the problem of having surplus food which they wanted to exchange to satisfy their other needs. This must be the primary stage of development of trade and commerce in the human history. Money was then unknown and exchange of goods used to be on barter. However, the initial human endeavour in trade and commerce was localised as means of transportation for covering long distances were still not discovered.

Men gradually learnt to sail across the rivers and seas by building sailing boats. This provided them the much-needed means of transportation of goods from one place to another and provided them further mobility.

As the civilisation progressed, human needs also increased which created more many-sided human needs and demands for variety of goods. As all the countries were not equally lucky in respect of natural resources, weather conditions and the same level of human skill, level of development became unequal. However, with the improved mode of transport and better communication system, the level of demand became more or less uniform practically all over the world. This resulted in large-scale trade.

Basic human demands can be classified as (a) Food ; (b) Housing ; (c) Transport and Communication ; (d) Education ; (e) Medical care and (f) Relaxatior.

Due to the unequal level of development and also availability of natural resources neither the various regions within a country nor all the countries are producing the basic needs in equal measure. This results in exchange of goods and services from the surplus to the deficit country. Furthermore, the division of labour in the present-day society also lends to exchange of goods and services.

While Trade and Commerce within the country is considered as domestic trade, trade between two countries are called International Trade. Payments for domestic trade are made by the individuals in domestic currency; while payments for international trade is made through some mutually acceptable currency by the respective Governments of both the countries.

Trade and Commerce; whether domestic or international, is largely dependent upon creation of more demands which again is dependent upon the level of Income, size of the population and various other factors like Technological Developments, etc.

A country with large population will naturally need more goods and services. But whether this would be restricted to the basic necessities or would also include luxury goods will be determined by the level of earnings within the country. The necessities are also dependent upon the climatic condition of a country ; people living in the cold countries of the West must have warm clothings; better shelter and good food to sustain themselves ; whereas people living in relatively hot countries may not need those things to the same extent. Similarly, a technologically developed country will need more petroleum whereas developing or under-developed country's needs for same may not be in equal measure.

However, as the pace of development has been uneven, so the increase in trade and commerce in all the regions of the world has not been similar. This has led to categorisation of world into various groups such as (a) economically developed countries (b) developing countries and (c) undeveloped countries.

Countries belonging to the West and North Europe and also USA; Canada; Australia, Japan etc., belong to the first group. They are rich in natural resources; industrial production and technological developments. Per capita income is very high in these countries. Hence; the demand for goods and services of various nature are also very high. These countries are mostly not exporters.

To the second group belongs the countries of Latin America, South and South-East Asia, some countries of Africa and Western Asia. They are rich in natural resources but due to slower industrial and technological development, these resources have not been exploited to the fullest extent. Besides, all these countries have a relatively large population. Hence; the level of per capita income and so also demand generation is low. Generally speaking, these countries export raw materials and import food, and finished or semi-finished industrial products.

Due to better exploitation of natural resources and growing awareness regarding self-reliance these countries are now making rapid progress in the field of industrial production and level of living is also steadily rising. This, in turn; is creating demands for more goods and services.

Undeveloped countries lie in the extreme end of the above classification. Due to lack of natural resources and also industrial development, level of living in these countries are quite poor and generation of demand for goods and services which are presently at a very low level will take considerable time. Their need is mostly restricted to basic necessities of life.

For the last ten years or so, International Economy and so also trade and commerce is passing through bad days. Steep increase in oil prices by the OPEC countries has made a visible impact on the economies of many countries including the developed countries. Many fold increase in 'oil bill' has compelled them to cut down their imports of less necessary items. Since 'import' of one country is the 'export' of another country, these moves have spiralled to stagnate the growth of world trade. In fact, during last few years world seaborne trade has been declining (Table 1).

Consequently, there has been widespread

TABLE 1 : World Seaborne Trade 1971 to 1982 in Million Metric Tons (Tonnes)

Year	Crude Oil	Oil Products	Iron Ore	Coal	Grain	Other Cargo Estimate	Total Trade Estimate
1971	1070	247	250	94	91	825	2577
1972	1185	261	247	96	108	866	2763
1973	1366	274	298	104	139	940	3121
1974	1361	264	329	119	130	1045	3248
1975	1263	233	292	127	137	995	3047
1976	1422	260	294	127	146	1075	3324
1977	1475	273	276	132	147	1120	3423
1978	1457	270	278	127	169	1190	3491
1979	1538	279	327	159	182	1270	3755
1980	1362	276	314	188	198	1310	3648
1981	1215	267	303	210	206	1305	3506
1982 Ext	1045	242	272	202	202	1250	3213

unemployment all over the world. In some cases, the level of unemployment has crossed 10% mark of the working force. This development, in its turn, is causing a further down-swing in the level of demand and unless this trend can be arrested, no one knows how the international trade and commerce is going to prosper.

India is one of the leading developing countries which has made rapid progress in the field of International trade in the recent past (Tables 2 and 3).

Exports being mostly of raw or semi-finished materials of relatively lower unit value against the import of high-valued cargoes like general cargo, petroleum and fertilisers etc., the adverse balance of payments position is readily visible.

TABLE 2 : Volume of overseas trade handled during 1982-83 through major ports of India

Port	In '000 Metric Tons Export	Import	Total
Bombay	2616	11044	13660
Kandla	525	7549	8074
Calcutta	941	5945	6886
Vizag	6018	3412	9430
Cochin	713	3528	4241
Marmagoa	11728	535	12263
Paradip	1049	523	1572
Madras	3743	7274	11017
Tuticorin	199	807	1006
Mangalore	1421	624	2045
Other minor & Intermediate ports	2713	1904	4617
Total	31666	43145	74811

TABLE 3 : Commodity-wise export/import position during 1982-83

Commodity	In '000 Metric Tons Export	Import	Total
General Cargo	4278	6152	10430
Coal	40	1381	1421
Salt	203	—	203
Food Grains	1080	2453	3533
Fertilisers	33	4077	4110
Iron Ore	22871	—	22871
Other Ores	1009	36	1045
Petroleum & Products	507	23510	24017
Other Bulk cargo	1645	5536	7181
Total	31666	43145	74811

Of late, oil prices are now showing signs of decline and reportedly a recovery is taking place in the U. S. economy—the leader of the developed countries. But this glimpse of recovery may not be lasting.

There is distinct school of thought amongst the students of political economy that the subjective conditions in the economic and political fields in the present-day world resemble more with the situation prevailing during the great depression of the 'Thirties' which culminated in the break-out of World War II. They argue that all the countries in the world spend a considerable portion of their 'gross national product' on defence expenditure. They further argue that since there has not been a war for quite sometime now, there is a considerable stockpiling of armaments. If the period of prolonged peace continues further, there is no scope for using the armaments which have already been produced. In their view, this would lead to further unemployment and deterioration in the world economy and so also trade and commerce. According to this thinking, any tangible improvement in the world economy can take place only if an all-out war breaks out involving the superpowers of the world.

However, as is known, any large-scale war activity in today's context cannot be limited to conventional methods only. This must necessarily involve nuclear weapons with high-destructive powers. Accordingly, there is a feeling that any future war involving nuclear weapons is sure to bring almost total extinction of mankind. This is too great a risk which can be taken by any nation and accordingly working as a deterent to any nuclear war being started on a largescale.

There is some truth in both the above view-points. While it is true that economic progress has been achieved through wars, there is also no denial that nuclear war might mean almost total destruction of the human civilization. But in the meantime, the world economy and so world trade and commerce has to revive and accordingly the chances of many local wars being fought such as being witnessed today in Afganisthan or Middle East cannot be ruled out. ☐

TEA, JUTE AND ENGINEERING GOODS AND CALCUTTA PORT AT 2000 A. D.

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DURING the last few years when the commodity composition of India's exports has undergone considerable change, the product mix of exports from Calcutta port has remained largely unchanged. Major items of export from Calcutta replenishing the eastern region are jute manufactures, tea, engineering goods, chemicals and allied products, coal and coke, iron & steel, ores and minerals, lac and tobacco.

This paper considers the trade performance of Calcutta port especially in respect of first three foreign exchange earners, tea, jute and engineering goods and allied port operations of Calcutta port. At present, as a single item, tea continues to be among the largest foreign-exchange earners for the country from the port. Second place should be given to jute manufacture. Next to jute, the eastern region is the pioneer in exports of engineering goods through the port. The possible performance of the port in exporting the three major items at the turn of the century is estimated in this paper.

Tea

The public sale of tea started at Calcutta since 1861. The activity carried a smooth development and a fair system emerged which made Calcutta the "Tea Capital of India" and Calcutta emerged as the foremost international auction centre for Indian tea. Since 1961, the pattern of primary marketing of tea in India has undergone certain changes affecting the tea trade of Calcutta.

Calcutta operates a two-way function for tea trade, as a tea auction centre and as an export point. In fact, for the essential export outlet, tea selling through auction has developed. In a recent period, the auction sale and tea export through Calcutta have, however, been fluctuating during the last several years as being shown in Table 1. The Table 1 is also illustrative to show the gradual fall in the tea-export function of Calcutta in respect of total output and total export of the commodity from India.

TABLE I : Tea Output and Sale through Calcutta (In million kg)

Year	Output	Total export	Export through Calcutta port	Offtake in Calcutta auction
1961	—	—	164	159
1971	436	195	106	150
1975	487	—	155	—
1976	512	230	196	187
1977	556	227	159	158
1978	571	169	120	148
1979	548	200	119	129
1980	515	226	141	133
1981	560	240	160	164
1982	564	186	131	120

Sources: (1) Calcutta Stock Exchange Official Year-book 1982.
(2) Capital, April 4, 1983.

This calls for attention to recent development in tea marketing in the country. At present, seven auction centres for tea are operating in India, out of which for the North-East Indian tea trade, there are two other markets playing the similar role as that of Calcutta in the region. Calcutta with Siliguri and Gauhati auction Centres in the north-east region is taking part with four other points at Amritsar, Cochin, Conoor and Coimbatore. It is, however, noted that these emerging centres, no doubt, are taking an increasing share of Calcutta market.

Apart from other fiscal and trading constraints operating at Calcutta, it is found that the sale of tea through Calcutta auction as the percentage of total production is declining. It has been declined gradually to 21% in 1981 from 45% in 1961. It is evident that though other centres are taking increasing share another development is notable, i.e. ex-garden sale which deliberately avoids the organised auction sale. The ex-garden sales in recent period bypassing Calcutta auction has gone up from 15 to 25%[1]. Table 2 is illustrative in this respect.

The tea industry is found to have a revival after its lack-lustre performance during 1981. According to an estimate by the Tea Board, the total production of tea during 1982 has reached 564 million kg against 560 million in 1981[2]. Even under the recent backdrop of declining export the domestic consumption absorbs nearly 60% of the total production[3]. Experts are of the opinion that the potential for internal consumption is increasing at the rate, more than 5% a year. For the future export of Indian tea, the silver lining appears through international trade meet recently organised under the aegis of UNCTAD in 1982 where useful conclusions for both exporters and importers are reported to have reached.

The country has planned to increase the production at an estimated level of 1000

TABLE 2 : Indian Auction Sale (In million kg)

Auction Centre	1961		1971		1981		1982	
	Qty.	% of total output	Qty.	% of total output	Qty.	% of total output	Qty.	% of total output
Calcutta	159	45	150	35	164	29	120	21
Siliguri	—	—	—	—	56	10	78	14
Gauhati	—	—	22	5	65	12	75	13
Amritsar	—	—	1	Neg.	Neg.	Neg.	Neg.	Neg.
Cochin	37	11	66	15	58	10	55	9
Conoor	—	—	9	2	17	3	14	3
Coimbatore	—	—	—	—	16	3	14	3
Total	196	56	248	57	376	67	356	63

Source : Capital, April 4-10, 1983.

million kg by the turn of the century[4]. This requires a hectic promotional efforts from the part of the government as well as planters. Thereby, the revival programme in terms of replantation and rejuvenation of garden is said to be carried out from government sector with required finance[5].

Notwithstanding the decline of auction selling at Calcutta, the port of Calcutta is the major gateway of tea industry and trade. With the proposed increase of the production of tea, approximately double the present quantity Calcutta will have to handle nearly double the present quantum at its auction as well as at the port by the turn of the century. The reason for the above estimate obviously centres on the growth of essential port facilities, Calcutta being the major outlet for tea exports, particularly for tea originating in the eastern region. Special berths have been constructed at Calcutta port for tea movement and other infrastructural facilities are being developed for better service to tea trade with the construction of container depots at special points in the north-east India[6] to facilitate the bulk movement of tea to utilise Haldia in a big way. The government's decision to construct an internal container depot at Haldia[7] for direct shipment of the commodity is a major step in this respect. Obviously the future assessment of Calcutta handling, at least, 500 million kg of tea during 2000 A.D. depends mostly on the success of the promotional activities of the government concern when the planters and traders would not be unwilling to cooperate.

Jute

Next to tea, jute products are the most important foreign exchange earners from Calcutta port. But in the current decade, the industry has entered a none-too-encouraging record of performance in respect of manufacturing and its performance at the export sector.

The causes behind the overwhelming concentration of jute manufacturing in the Calcutta industrial belt lies in the fact that port and commercial centres of Calcutta along with cheaper inland water transport and overseas shipment facilities provide a big advantage to this export oriented industry. The industry made a fairly encouraging result in the third and fifth plan periods obtaining a growth rate at constant prices[8]. But in the last part of the seventy's decade the industry performed a decline in net income per factory and erratic performances in other respects come forward (Table 3).

In terms of near monopoly of jute manufacturing the Calcutta Industrial Region (CIR) at present undergoes through a crisis of great magnitude. The analysis provided by the Calcutta Stock Exchange Association showed that during 1981-82 the profitability of the industry in the region is almost vanished; mills were forced to sell their finished products below the cost of production. But the few mills which have modernised their equipment and diversified their products are able to sustain normal level of working profit[9]. The total production of jute goods during 1981-82 was to the tune of 1108 thousand tonnes

TABLE 3 : Trend in Jute Industry in the Calcutta Industrial Region (CIR)

	1975-76	1976-77	1977-78	1978-79
Number of units reported in the CIR	64	61	74	72
Total output in 000 Rs. ...	3364	4043	3964	4676
Net income in 000 Rs. ...	1267	1308	1084	1249
All employees	221616	234398	213389	235585
Output per factory in 000 Rs.	52.56	66.28	53.57	64.95
Net income per factory in 000 Rs.	19.80	21.44	14.65	17.35
Employment per factory	3494	3842	2883	3258

Sources : Annual Survey of Industries from 1975-76 to 1978-79.

against 1191 thousand tonnes in the previous year. During the past two years, the industry has been loosing nearly Rs. 100 crores a year[10]

However, it is felt that though the performance of the industry is hamstrung with severe constraints during 1981-82 the long-term outlook of the industry is not bleak. The internal market has been growing at an estimated rate of 7% a year (Table 4). The encouraging feature is the government's increasing interest of late. The Central government has taken a number of steps which include stimulation of demand by increasing government purchase of jute goods[11], government's cash-compensatory support for export of jute goods etc. The government is urgently compelled to take action, because the export has been shrinking at fast pace.

Obviously, the export earning from Calcutta port is getting eroded due to shrinkage of jute export. It is found that at present 30% of the products are sent to export market. Table 4 shows the loss of export and growth of internal sale. The causes behind the declining performance of export sector for jute from Calcutta port are mainly held by the fiercely competitive international market owing to price competition and alternative product development, especially the synthetic products.

The government's measures in this respect is focussed at the long-term outlook for the industry. The Central government has set up two consortia between the State Transport Corporation (STC) and exporting mills to secure overseas orders, especially through global tenders. The arrangement is made that if loss occurs, it would be shared equally by the STC and exporting mills. These measures recently has yielded good results as is evident from Rs. 1 crore global tender which the STC has secured recently even against the fierce competition from Bangladesh, China and Thailand.

The prospect has brightened following the EEC's commitment to elimination of tariff and quota restrictions on all imported jute goods from January 1984. The product development in line of odour-free rice bag is a hopeful regaining affair to take back Japanese rice-bag market. The other encouraging features to developing product varieties of jute in the industrial units in the CIR, readily acceptable in international market, are the new process for producing flat-ribbon type of twistless yarn, the possibility of jute fibre as sandwich material for reinforced plastics etc[12]. Thus, the export outlook during the rest of the years

TABLE 4 : Total Consumption and Export of Jute goods

Year	Total Consumption ('000 tonnes)	Export ('000 tonnes)	Internal consumption ('000 tonnes)	% share of export in total sale	Value of export (Rs. lakhs)	% share of export by value
1965-66	1224.6	808.8	415.8	66.1	—	—
1970-71	1036.3	578.5	457.8	55.8	26528	16.06
1971-72	1146.4	656.2	490.2	57.3	—	—
1972-73	998.2	534.5	463.7	53.5	—	—
1973-74	964.2	565 0	399.2	58.6	—	—
1974-75	939.9	501.8	438.1	53.4	29568	9.0
1975-76	1098.4	439,2	659.2	40.0	—	—
1976-77	1037.7	453.6	584.1	43.7	—	—
1977-78	1059.9	495.7	564.2	46.8	24484	4.6
1978-79	928.3	345.2	583.1	37.2	16657	2.9
1979-80	1129.7	439.4	690.3	38.9	33742	5.3
1980-81	1158.6	406.0	752.6	35.1	33008	4.9
1981-82	1127.3	360.1	767.2	31.9	—	—

Source : Calcutta Stock Exchange Official Yearbook, 1982 of the century is one demanding cautious optimism.

While the exports have averaged 5.35 lakh tonnes per year during 1970's* it came down to 3.83 lakh tonnes during the first two years of the current decade against the target of 4.0-4.5 tonnes fixed by the Central Government for the decade[13]. At the same time, the export from Calcutta as percentage of total production has declined from 53% in 1970 to 25% in 1981-82. The rise of internal sale, deviating from increased export consumption, reduced the export earning of the industry considerably. From the traditional position of dominance India has sunk down to a secondary position in the international jute market. Obviously, the performance of jute industry has compelled Calcutta to lower its position as an export-earning centre.

The realisation of a cautious optimism of performing 4.5 lakh tonnes annual-export performance requires considerable activity in line of modernisation of units and evolving of new products. It would demand from time-to-time involvement of further investment and new technology. It is assumed by far, considering the present and future condition, Calcutta port may secure at best, a steady income of foreign exchange basing on more or less 4.5 lakh tonnes export average per year of jute products.

The question may be raised why not a steady rise in export per year in view of expected development before 2000 A.D. The gradual development of alternative product varieties as against jute goods erodes the possibility of the growth of jute product market in the international sphere.

Engineering goods

For engineering-goods exports, West Bengal acquires a very important position. In the eastern region, the Engineering Export Promotion Council (EEPC)[14] has 1069 members at present, out of this in Orissa there are only 90 members and from Bihar only 52. It makes certain that the export effort of the region has more or less confined to West Bengal, as a matter of fact, to Calcutta and Howrah.

In 1982-83, the eastern region accounted for exports of engineering goods valued at about Rs.185 crores and Rs. 175 crores in 1981-82 but some years back it touched Rs. 250 crores[15]. It is expected by the EEPC that this region will be hitting the target of Rs. 250 crores for 1983-84. In Calcutta-Howrah region, for various reasons today, the capacity utilisation of engineering industry is not higher than 30 or 40%. Therefore, the pull of the domestic market, as it is found, spares no surplus for exports. The output scarcity of the eastern region is the fact that Calcutta is losing goods' traffic for export while such traffic is growing in Bombay and Madras.

Apart from output scarcity, the low-capacity utilisation makes the product price a bit higher. The production of steel ingots, under the licensed capacity in the state evidently shows the persent level of performance. Out of licensed capacity of 410 thousand tonnes, the production of mild steel, high carbon and alloy steel together accounted for 189 thousand tonnes in 1981-82 while the all India output figure was 2161 thousand tonnes during the period[16].

The freight disparity at Calcutta also poses a problem for shipment of engineering goods. Calcutta fails to reach the competitive level so far as exports are concerned. The freight disparity[17] between Calcutta and other Indian ports builds up a gap of 20 to 25%. The market competitiveness of Calcutta goods rather sinks down because lower prices of steel goods are found to be offered by the competitors in the Western region. This is the official view of the EEPC, eastern region[18].

Notwithstanding, the higher capacity utilisation lowering down the cost of production as well as market price, under the Indian situation at present, a general lack of demand for many engineering goods is prevailing high. It is reflected simultaneously in the export market. For the unfavourable situation various factors are traceable. The recent decline in agricultural production is found to be followed by a slow down in the growth of industrial production which, in its turn, reduced the demand for engineering goods in the country.

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*Obviously excluding the abnormal year of 1978-79 when exports slumped to 3.45 lakh tonnes largely, because of supply interventions due to strikes and port troubles.

Another constraint appears recently in the form of shortage of capital, following the pursuit of a restrictive credit policy. The situation has worsened further, because most engineering units in CIR suffer from lack of modernisation. It is also found that the units which have modernised their machinery and have adopted updated technology are doing fairly well[19].

Among non-traditional items, export performance of engineering goods in India maintains really upward trend. But the eastern region, which was once the pioneer in exports of engineering goods, could not maintain its position. It has certainly registered a growth of export, but its share in the country's total exports of engineering goods is sharply declining. All India rate of growth of export does not reflect the similar performance in case of eastern region. Table 5 is illustrative in this respect. It appears to show that from 66% in 1965-66 the export of engineering goods from Calcutta in 1982-83 scales down to 14.23% of Indian export. Its export index from 1965 grows to 953 point only while in 1982-83 all-India performance rose to 4420 point. For the last three years, all-India annual export growth rate of engineering goods is 21-22%. Assuming the growth rate of value of export goods at 15% a year at 1982-83 prices for the rest of the years of the eighty's decade, it is found that in 1990 the prospect of export performance would be, at all-India level, Rs. 3980 crores from Rs. 1300 crores in 1982-83. Coming down to a growth rate at 10% a year for the last decade of the 20th century, it is assumed that total export would be Rs. 10305 crores at 1982-83 prices in 2000 A.D. (Table 6).

TABLE 5 : Engineering Exports from Eastern India

Year	All India exports	Growth Index	Exports from Eastern Region	Growth Index	Region's share in percentage
1965-66	29.41	100.00	19.41	100.00	65.99
1970-71	115.77	393 64	23.82	122.72	20.57
1975-76	408.22	1388.03	64.56	332.61	16.00
1978-79	717 00	2437.95	160.00	824.32	22.00
1979-80	650.00	2210 13	90.00	463.68	13 85
1980-81	874.00	2971.78	150.05	773.06	17.16
1981-82	1060.00	3604 22	175.00	901.60	16.50
1982-83	1300.00	4420.27	185.00	953.12	14 23

Source : Capital, Mid year special number 1983, p. 37.

Apart from the situation of technological growth-performance of engineering industry in India, some international inhibiting factors must be taken into consideration. These are global recession in international market, market encroachment due to debt-rescheduling factors of developing countries, protectionist policy of the developed countries, fierce competition in international market of engineering goods and inadequate support from international financial institutions.

Internal factors inhibiting exports are delay in policy-implementation, inadequate industrial base ; inadequacy of supply of basic inputs and raw materials at internationally competitive rates, and especially for its eastern region the added impeding factors are, lack of modernisation of industry, lack of power and port facilities.

Assuming a better condition of engineering industry in the eastern region and improvement in port facilities at Calcutta, the rise of export volume of engineering goods from Calcutta at 2000 A.D. would be Rs. 2060 crores, i.e. 20% of all-India volume (Table 6). It should be remmebered that the latest performance of eastern region at Calcutta, in this

TABLE 6 : Engineering goods export possibility from Indian ports and Calcutta port

(Rs. in crores at 1982-83 prices)

Year		All India export	Export from Calcutta
1982	(actual)	1300.00	185 00
		Estimated increase at the rate of 15% per year	Estimated at 20% of all India export
1983	estimated	1495	299
1984	"	1720	344
1985	"	1980	396
1986	"	2275	455
1987	"	2615	523
1988	"	3010	602
1989	"	3460	692
1990	"	3980	795
		Estimated increase at the rate of 10% per year	
1991	"	4378	875
1992	"	4815	963
1993	"	5295	1059
1994	"	5825	1165
1995	"	6405	1281
1996	"	7045	1409
1997	"	7745	1549
1998	"	8520	1704
1999	"	9370	1874
2000	"	10305	2060

respect, rotates round at 15% only, i.e. the average rate for 4 years during 1979-80 to 1982-83.

The assumption of better performance of 20% growth rate at the export sector, calls for new industrial investment and production of new types of products which have good international markets and elimination of inhibiting factors in the production sector.

A study of the performance of engineering industry of eastern region enlisted with the Calcutta stock exchange reveals that during 1977-81, 33 regional engineering units out of 45, performed asset growth 69%, sale growth 86% and gross product growth 135% at current prices. This over-all growth performance being an encouraging factor at the present bockdrop it would not be an ambitious prospect for engineering industry in the near future in the eastern region to spare a surplus of 20% for the export sector during 2000 A.D. from Calcutta port.

Calcutta Port

Calcutta port was the premier port of India till 1954-55. Grown up to serve the needs of a vast hinterland and meeting the demands of one of the biggest and richest industrial belts of the country, the port attained a premier position as well as built up, in course of time, a vast infrastructure of its own. The ports handling of cargo, at present, has been lowered at 8 or 9 million tonnes per year, but there was a time when the port handled morethan 11 million tonnes of cargo of diverse characteristics. In the years 1928-29, 1929-30 and again in 1945-46 and 1964-65, it rose to handle as much as 11 million tonnes of cargo[10]. The total tonnage for foreign trade in Calcutta port was over 25% of all India total before the mid sixtys of the century (Table 7).

As a port, Calcutta dock system developed itself as major export outlet. In comparison to import, it sends even today more goods to foreign market and adds substantially to the foreign exchange earnings of the country which, in its turn, primarily accounts for the progessive development of trade, commerce and industry of the CIR and its hinterland—the eastern region of the country. Even today the exports from the port account for almost 25% of the total foreign exchange earned by the country as a whole and imports 12% of the value of tonnage[11].

The output of Calcutta port has declined steadily since 1964. The cargo hadling went down gradually with the gradual decline of bulk traffic in iron ore, petroleum and its products, foodgrain imports, etc. The progressive loss of depths in the upper reaches of Hooghly preventing large and deep-drafted ships to come up to Calcutta has compelled the authority to build a new dock system down stream from Calcutta at Haldia.

Most of the physical problems of the port are due to sandbars inside the river, numerous bends on the river flow system and tidal bores which frequently come up from the sea. These physical obstructions restrict severely the draft and size of the ships entering the

TABLE 7 : Gross Registered Tonnage : Foreign Trade India and Calcutta

(Quantity in '000 tonnes)

Year		Calcutta	India	p.c. of Calcutta to India
1960-61	Exp.	5492	22653	
	Imp.	4019	11116	
	Total	9511	33769	28.16
1965-66	Exp.	5284	28202	
	Imp.	4564	14550	
	Total	9848	42752	23.06
1970-71	Exp.	3247	25443	
	Imp.	2767	30247	
	Total	6014	55690	10.80
1971-72	Exp.	4750	29823	
	Imp.	2544	29189	
	Total	7294	59012	12 36
1972-73	Exp.	4148	28595	
	Imp.	2531	29208	
	Total	6679	57803	11.56
1973-74	Exp.	3890	32074	
	Imp.	2435	31787	
	Total	6325	63861	9.91
1974-75	Exp.	5085	34260	
	Imp.	2450	31331	
	Total	7535	65591	11 49
1975-76	Exp.	4479	32047	
	Imp.	3220	32167	
	Total	7699	64214	11.99
1976-77	Exp.	4861	31765	
	Imp.	3157	34970	
	Total	8018	66735	12.03
1977-78	Exp.	3965	31308	
	Imp.	3584	33073	
	Total	7549	64381	
1979-80	Total	8600	801000	
1980-81	Total	9290	—	

Source : Statistical Abstract of India

port and the progressive loss of number of such slips entering the port reduce the actual working of the riverside jetties and river moorings, further more, the riverside working is not possible during bore tide days—the number of such bore tides are increasing day by day

With the gradual degeneration of Hooghly as a seaway traffic, the essential infrastructure of the port and the facilities available have become old and obsolete in comparison to the rapidly developing technology of international shipping and cargo handling practice. From one official report[11], it is learnt that the number of jettics alongside the river, all the dry docks numbering five, large transit sheds, number of wharf cranes, mobile cranes, forklift trucks, and various other plants and equipments, all have become old and decripit requiring immediate replacement. Added to this, setbacks of the industry in the hinterland of the port have seriously affected the port's viability. Further obstruction appears with the unfortunate tendencies for the seaway outlet for tea and jute to shy away from Calcutta port. With its old and outmoded handling equipment and low output, it cannot offer quick turn round of ships, thereby increasing gradually the waiting period of the ships at the sandheads as well as in port, consequently, increasing the cost involvement of the shippers.

The official assessment [8] of 1978-79 critically reviews the usual productivity of labour at Calcutta port which is declined because of overage of the men who are at present at service. It is alleged that there has been no recruitment for the last 20 years on the cargo-handling side. Most of the cargo handling labour up to that period of assessment was above 40 years of age.

Improvements in the working of the port may be facilitated by sustained measures bearing on management of men and materials, renewal of technology of portbased industry. It is essential to emphasise and locate certain measures like restoration of head water supply from Farakka, River Training Works and capital dredging below Diamond Harbour and research, renewal and remodelling of civil engineering infrastructure connected with port operations, acquisition of new mechanical and handling equipments and offer of liberal facilities to shipping. The port industry is basically an uninterrupted exercise in coordination of its functional discipline whether within or outside. Improvements desired could be attributed to sustained measures bearing on management of men and materials, reorientation of channel management and a matching strategy to handle increasing volume of goods. This can lead to quicker and better results.

An assessment made last year (1983) found that drafts for ships calling at Calcutta and Haldia ports have been showing improvement. It is reported that some development measures are being adopted in the Calcutta port with the assistance of the Minister of Shipping and Transport for bettering the port operations. In the recent period, the trade is coming forward with more traffic at Calcutta port. The upturn in the port operations is said to be a consequence of planned strategy. The average monthly tonnage loaded in 1981 was 3.45 lakh tonnes as against 3.06 lakh tonnes in 1980. The average monthly handling[24] of containers has gone up to 1390 as against 4.6 in 1980. Similarly, the average monthly figure[25] of ships entering the port in 1981 has gone up to 67 from 57 in 1980. There is a marked reduction in pre-berthing detention and the turn-round period for a ship has also come down in 1981[26].

It is thereby expected that cargo handling to be regained in the near future to the tune of 11 million, tonnes. For the cargo of 11 million tonnes under the port operations, it has been allocated on a 50 : 50 basis between Calcutta and Haldia[27]. The figure of tonnage handling at Calcutta port system during 1977-78 to 1980-81 shows a continuous improvement from 7.8 million tonnes to 9.9 million tonnes (Table 8).

The successive improvement of port facilities and the growth of general trade and industry in the hinterland area would further pressurize its impact on the port operations. From 1977-78, the growth rate in tonnage handling at Calcutta is 6.75% per year. This rate, however, would not prevail for long. There is limitation in handling of tonnage at present at Calcutta which is restricted at best, at 11 million tonnes. With the phased development of port operations in the remaining years before 2000 A.D. the expectation with cautious optimism reaches to future handling of 15 million tonnes only. The present growth of volume of the major commodities coming at Calcutta port, as it is estimated, in case of tea, jute and engineering goods, may reveal that the total-handling operations of the port would not cross over a 50% growth from its level of 1981-82.

TABLE 8 : Cargo handling at Calcutta Port
(Quantity in '000 tonnes)

Year	Total sea borne cargo	Inland cargo	Total tonnage
1971-72	7359	510	7869
1972-73	6680	515	7195
1973-74	6325	443	6768
1974-75	7536	388	7924
1975-76	7699	302	8001
1976-77	8018	309	8327
1977-78	7549	257	7806
1978-79	7979	259	8283
1979-80	8555	240	8795
1980-81	9290	222	9512
1981-82	9750	176	9926

Source : Government of West Bengal, Economic Review, 1982-83

There must be a limit to growth of the port facilities of a river-based port system, especially, under the river regime of the Ganges. □

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SEMINAR ON CALCUTTA BEYOND 2000 A.D.

IX. COMMUNICATION

ON COMMUNICATIONS

(Key-note Address)

J. DAS

IIT, Kanpur

WE have just celebrated 1983 as the World Communications Year, designated by General Assembly of the United Nations. The resolutions of the General Assembly states :

"The General Assembly, recognizing the fundamental importance of communications infrastructures as an essential element in the economic and social development of all countries.

Convinced that a World Communications Year would provide the opportunity for all countries to undertake an in-depth review and analysis of their policies on communications development and stimulate the accelerated development of communications infrastructures :

(1) Proclaims the year 1983 World Communications Year : Development of Communications Infrastructures, with the International Telecommunication Union serving as the lead agency for the Year and having responsibility for coordinating the interorganizational aspects of the programmes and activities.

(2) Requests all States to participate actively in the attainment of the objectives of the World Communications Year".

In pursuance of the above resolution, the various organizations, specially the Ministry of Communications, in India held many seminars and get-togethers to further the cause of the World Communications Year.

U. N. General Assembly has recognized that communications are essential elements in the economic and social development of all countries, specially the developing nations, but unfortunately this has not been appreciated in this country. Apart from the needs of the Government, industries and the elite, there is a strong need of telecommunications in the area of Agriculture, Health care, Education, Planning and Rural development. With the progression of the society from an agricultural base to the industrial base, and then to the post-industrial base, the telecommunication has emerged as central technology, supporting virtually all economic and social activities. It has, therefore, become very important to evolve the concept of interactive planning with community perticipation in the future decisions for telecommunication development. Telecommunication and Broadcasting should not be the exclusive empires of the Government departments, but these should be the joint responsibilities of all concerned, dealing with national development, health care, education, etc.

Indian Scene

It is unfortunate that in India the development of telecommunications has remained the exclusive responsibility of one Ministry and the result is that the standard of our telecommunications is far worse than in many other developing nations. Consider one important aspect of the national activity, e.g. the planning and the plan implementation. We have been hearing that we should go for grass-root planning, meaning thereby, that the people at all levels of the society and regions should be involved in the total planning and plan implementation process. We do not have any means of getting any feedback from the rural areas and our statistics can not be depended, since we have no method of checking our data. However, some small efforts in this direction have been started in the form of the National Informatic Centre at Delhi, which is now serving the requirements of many Government Departments and the Planning Commission, but only in Delhi. Recently, the Government of Madhya Pradesh has acquired a large indegenious computer (ECIL-332) to monitor the performance of projects and plans and to develop a Data Bank for Public Accounts, State Electricity Board, Forest department, the Department of Statistics and Economics and also the Personnel information. They also plan to have a comprehensive rural information system for 77,000 villages, covering the details of socio-economic importance of the village demographic information, basic agricultural statistics, and data concerning schools, hospitals, drinking-water facilities, roads, etc. Hopefully, the M. P. Government will be successful in this venture and then they will become one among the pioneers in the country in this field. However, to develop such a large network, one has to have decentralised control and each of the stations will be a microprocessor based system. Then imagine the requirement of 77,000 such intelligent terminals, which will have to be manufactured in this country. But, the above activities have been organised outside the Ministry of Communication.

The General Indian scene in telecommunication is known to every body and is really gloomy. The quality of service over the last two decades has deteriorated considerably, although we have now more numbers of telephones installed (but how many of them are working ?). It has always been said that the investment in telecommunications in the country has not been commensurate with the demand. Since the requirement of communication is all pervading, then everybody concerned, e.g. agriculture, health; education, planning and rural development sectors, should pool their resources for the overall development of the telecommunications. Moreover if the special needs of large users such as the Railways, Power Sector, Law and Order, etc., are decentralized, then the responsible ministries will be able to find their own resources for the development of their network. Ministry of Communication may then look after the needs of other miscellaneous users only. But the thinking in the Government does not seem to have changed and no innovative measures are contemplated as yet. As a result there is hardly any hope for a specticular improvement in the national telecommunication networks in near future.

Global Scene

Having considered the national scene, we would like to look at the global scene in telecommunications. Futurologists have made the forecast that by the end of this century, the developed countries will be in the Information Age and they are now passing through an Information Revolution—a revolution much more significant than the Industrial Revolution of the last century. New information techniques in the form of video-tex, electronic mail, teleconferencing and inter-active CATV, have come to stay and the special networks are being put into service to provide these facilities to the public. This Information revolution is also associated with the Digital revolution, resulting from the specticular development in solid-state electronics, Computers, digital switching and transmission, satellites and optical fibres. All these are leading to Automated offices and Wired homes, where most of the future information will be generated, processed and utilised for running the industries, business and the Government, and for education and recreation. By the turn of the century, we shall have paper-less offices and robotized homes and hopefully, people will have a lot of leisure and improved quality of life, at least in the developed countries. The important point to be realised is that all this will be possible, if our information and telecommunication systems work perfectly, and the networks are really socialistic in terms of distance and the class in the society.

Calcutta Scene

After having a look at the national and the world scenes, we may now have a look at the telecommunications in Calcutta past, present and future. The experience of Calcutta over the decades will tell us that the quality of service has definitely deteriorated over the years and there is little hope of its improvement in the near future. Even the most simple telephone instrument used by the subscribers is of much worst quality today than it was 20 years back and, of course, the success of a telephone call in the city depends on the subscriber's luck only. There is no dispute that there are many valid reasons for this and hardly any useful purpose is served by shifting the responsibilities from one Government department to the other. But on the other hand, is it not desirable, in fact essential, that our Banking and Commercial Sector should have a data network of their own for the efficiency of their services and operation? Is it not desirable that all offices in public and private sectors should have faultless telex services available for 24 hours? Is it not desirable that the public at large in the city should have access to coinbox telephones at street corners which will actually make the correct connection? Is it not desirable that one should be able to make successful reservations and enquiries for trains and planes? If the city's law and order situation is to improve, then it is necessary that the authorities should have facilities for instant communication to and from different locations in the city. Recently, I had the experience of the present status of telecommunications in the European countries and I found that it was possible to make an international telephone call, even from a small town, instantaneously and efficiently. One could also make reservations both in trains and planes without any uncertainty, as is experienced in this country. Such a situation is unthinkable in this country, even in the capital city of Delhi.

Social scientists may say that this is a reflection of the general quality of life in the city and one may argue that if the transport system is unsatisfactory, then why not the telephone system be so? Any way, it should be a very interesting problem for the System Analysists and Futurologists to try to make a forecast for the quality of telephone services in 2000 A.D. Based on the data and experience over the years, it is safe to say that after 20 years, hardly any telephone call will be successful, unless there is a quantum change in the equipment, methodology and operation of the telephone system. I am not sure that a tradition-loving nation like us will be able to take such a quantum step in near future.

Recommendations

The Ministry of Communication has proposed Rs. 12,000 crores as the plan expenditure for the 7th Five-Year Plan, which is more than five times the Sixth Five Year Plan allotment. They also say that the big cities, like Calcutta, Bombay, Madras and Delhi, will be taken up as special cases for improvement in their services. Granting that all the money is available (which is very doubtful), I have my personal doubt if this exercise is going to be successful. What is lacking in our efforts in this country is the induction of innovation and new thinking even if unorthodox, as has happened in our industrial sector. We are generally unable to dissociate ourselves from the long-standing principles and methods which have been followed by now-rich countries over centuries. But at the same time, we wish to cover up the gap in a few decades, where others took centuries. Moreover, the total bureaucratic control over our planning and implementation without any association of the society at large has not produced the best results. It is, therefore, necessary to provide an interactive organizational structure for our planning and implementation of telecommunications, preferably, a Telecommunication commission along with a Telecommunication Technology Centre, created for the induction of new technology and their innovations. One has to seriously think whether the present network should be completely scrapped and a new modern network be established using electronic exchanges, fibre-optic trunk cables and supporting microwave networks, etc., as it is felt that any amount of patchup for the existing network will not be successful in the long run. Perhaps, it will be desirable to have a metropolitan network as an independent network controlled by an independent body, but having suitable access to the national and international networks. This may be set up as a basic utility, for which the necessary funds may be raised through public borrowings and investments, as is done to set up a public-sector industry. I am sure there is no lack of money in Calcutta (if M.P., a poor state, can plan for a statewise multipurpose Data Network, Calcutta can surely afford a new Telecommunication network for the city), but what is necessary is to channelise the resources in the proper direction and at the same time, for the benefit of the people of Calcutta. Then only, we may retrieve some of the past glories of this great city of Calcutta. □

ROLE OF TELECOMMUNICATION IN URBAN DEVELOPMENT

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ALTHOUGH it may sound somewhat surprising, telecommunication is destined to play an increasingly important role in determining the future growth and development of a metropolitan city. Time was when cities used to spring up along rivers, railroads, etc. But cities of the 21st century will grow up in places that have access to modern electronic communication. The importance of communication arises due to an explosion of new technologies and services in this field such as satellite communication, microwave transmission, etc., availability of which will in future become as vital a need for a city as water supply, electricity, roads, etc. Telecommunication will be the medium through which future trade and commerce of a city will be conducted. Already, telecommunications has been occupying an increasingly large part of the cost of doing business of the types that process and transmit information such as banking and other service industries. It will influence in a marked way the residential choice of the people and will have profound effects on public services of the city like health, education, transportation, etc., thereby influencing traditional types of urban planning.

Telecommunications for a city was once exclusively a telephone service and inspite of all the advances that have been made in the field of communications in recent times, telephony still remains and will continue to be one of the most widely used form of communication in a big city like Calcutta. It is, however surprising that even after a hundred years, the basic system in telephony, viz. connecting central nodes to a large number of individual users over a pair of copper wires remains unaltered. It goes without saying that telephony will have to undergo radical changes to meet the ever-increasing demands of a growing metropolis. The primary change needed is a switch-over from analogue system to a completely digitalised network comprising not only the inter-exchange medium, but also the local exchange and the subscriber's instrument together with the cable connecting it. Such an integrated digital network will provide vastly improved system performance at a cost that is expected to go down with improvements in technology. In our country, fully digital electronic exchanges have already been slated for introduction and local manufacture of such equipment will commence in the near future. Digitalisation of the subscriber equipment, however, is still not on the cards. Again, with rapid increase in the amount of traffic to be handled, intensive studies will have to be made to solve the problem of congestion. One suggested scheme involves a time-shared wire or group of wires ranging in length from a few tens of metres to a mile or so, connected to a group of terminals that share access to a single, long-distance, possibly a broadcast channel.

Advent of satellite communications has opened up new vistas in the transmission of information. We are already accustomed to long-distance telephone service by satellites. Serious consideration should, however, be given to the possibility of using satellites for a metropolis connecting the city with remote villages and other far-flung areas of the state. The linking of high power satellites and low-cost solar-powered earth stations with VHF terrestrial communications systems can allow the objective to be achieved. This task may even be easier than developing conventional wire system or microwave networks. Application of the store and forward principal in satellite communication with low-cost satellite receivers should also be considered as an adjunct to the aforesaid telephone facility. In the store and forward principle, as is well known, the message is first recorded in a suitable memory and then the recorded packet of information is transmitted at any desired speed to suit the Network traffic and management needs. The S & F principle can be used both in message-switching and in circuit-switching.

With increasing use of microwaves, a time may, however, come when a particular congested area may be overloaded with microwaves traffic so that it may be impossible to find routes in or out of the city or to communicate with satellites. A solution may be to build a farm of satellite antennas in a place, which we call a "teleport", some distance away from the city to which it will be connected through higher capacity optical fibres in underground cables. For the New York area, which is already facing the problem of microwave congestion, plans are afoot to build a "teleport" in an area of Staten Island which is virtually free of interference. The antennas would be connected to offices in the New York-New Jersey area by high capacity optical fibres.

As cities like Calcutta grow, efficient traffic control within the city assumes greater importance. Telecommunications and computers should be used much more extensively than at present for monitoring and guiding the flow of automobile traffic. By providing information at every major bus or train stop about routes, schedules, transfer points, the current passenger load, the estimated time of arrival of the next bus, etc., the efficiency of mass-transport systems may be vastly improved. Also, it may be possible to keep track of the location of each vehicle and of the situation along each route with respect to the number of passengers, waiting, boarding and leaving. In Calcutta, such types of traffic information system may be quite useful and feasible even before the 21st century.

The world has already entered the age where the telephone, the television and the computer are being tied together in what is called a computerised communication system. Such a system enables the subscriber to gain access to data bases, to send out messages electronically, engage in two-way video conversation, etc. Although the cost of a system of this type is now prohibitive, it may well be within the reach of many by the turn of the century because of rapidly declining costs of microprocessors, (falling by 22% a year) computer memories (down 40% a year) and communication equipment (down 11% per year). For cities like Calcutta to survive in future, a computerised communication system will be an indispensable necessity, because it will permit people to live outside the city, stay at home and link themselves with central work-sites using telecommunications rather than transportation. The result would be a greater movement of ideas and information and less of people and physical objects. Indeed with intelligent terminals efficiently connected by telecommunications, there will be no need for a large number of people working at a single, central location. Such 'telecommuiting' will, therefore, replace transportation by communication and lead to the development of small urban centres, not very far apart but closely held together by high capacity communication links. A re-organisation of metropolitan areas involving dispersal from major cities will, therefore, be possible.

With interactive two-way communication of the type referred to above, volume of data traffic will be growing at a faster rate than voice traffic ; in fact, the former may even over-run the latter. It would obviously be desirable to transmit all the information in a uniform way, such as in a packet format. It may be noted that plans are already on the way to use a single standardised network, connecting different services from different subscribers, such as voice, data, facsimile, teletext, etc. Although such an integrated services Digital Network has not yet been realised, the possibility of such a system materialising in the early part of the coming century is indeed bright.

Developing countries are greatly to benefit from a recent innovation in communications technology, viz. optical-fibre communication, in which information is transmitted through glass fibres using bursts of light. In the field of technology, it has already been established that glass fibres possess many advantages over copper wires, such as small size, large bandwidth, increased channel-handling capacity, etc. For example, a single fibre can carry 10,000 times as many telephone conversations as can be transmitted through a copper wire. Also, optical fibres would be highly suitable for the computerised communication system referred to earlier because of their larger bandwidth.

It has been aptly suggested that developing countries will have more incentives to implement optical-fibre communication systems than the industrially advanced countries which have already made large investment in electrical communication systems and as such may not find it economical to switch over to fibre optics on a large scale. This is, therefore, an opportunity which developing countries should not let slip off. The fact that we have still not been able to provide the basic communications facilities all over our country should not stand in the way of our making the required preparations for developing in a big way the modern technologies in the field of communication. Indeed, high-technology communication is not necessarily inappropriate for a developing country. Communication needs of Calcutta have been neglected for long. Further apathy will only lead the city to disaster. ☐

TELECOMMUNICATION BEYOND 2000 A.D.

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WITHIN six years of invention of telephone in 1876, India was one of the few countries to have an operational telephone system in three metropolitan cities. At the time of independence, the number of telephones grew to 80,000 which was indeed low figure after 65 years of introduction of the service. To-day the number of telephones in India is approaching three million, i.e. in about 35 years the number has increased by more than thirty times which by itself would sound impressive. Still, when viewed from the overall perspective of economic, industrial and technological growth and the quality of service, the situation is far from satisfactory. Lately, the telecommunication services have come under severe criticism for its inadequacy, which, in a way, is indicative of realisation by the users as well as the policy makers that telecommunication is an essential component of the infrastructure required for overall national growth. There is a need to analyse our past performance and what decisions are to be taken to stimulate the growth of this important sector so that the demands of rapidly industrialising society like ours can be met. The planners have to meet the challenge of bringing the telecommunications in India to a stage where it can co-exist and compare with the world's best telecommunication systems at an early date and surely not later than the turn of the century.

Telecommunication in India and Abroad

Realising the essentiality of reliable telecommunication for economic growth, the developed countries and many developing countries have invested and are still investing a significant percentage of their Gross Domestic Product (GDP) in the sector. Telephone densities (number of telephones per 100 of population) of the order of 50, to 80 have been achieved in these countries and the demand for new connections is almost immediately satisfied (Table 1). In India, average telephone density is 0.4%. Even in the metropolitan cities it ranges from 2% to 4% compared to 4.8% of Bangkok, 7.7% of Manila, 8.7% of Teheran and 19.6% of Singapore. Inspite of sufficiently high telephone density the developed countries are investing about 1% of their GDP in telecommunications. In India, the average investment from 1965 to 1975 has been 0.17% of GDP which compares very poorly even within the average of .35% of the developing countries (Table 2). The consequences of continued low investment are manifold.

TABLE 1 : Density of telephones (percentage of population) as on 1.1.1981

Country	%
World	19.1
USA	83.7
UK	49.6
Canada	67.2
France	45.8
Italy	33.7
Sweden	79.5
Singapore	29.1
Japan	49.5
India	0.4

TABLE 2 : Average annual investment in telecommunications as a percentage of Gross Domestic Product (GDP)

Country	% of GDP
USA	.83
UK	1.23
Canada	1.07
Italy	.82
Japan	1.05
France	0.68
Sweden	0.43
Singapore	0.05
Malayasia	.34
Thailand	.03
India	17

(a) Insufficient exchange capacities leads to heavy-traffic congestion and loss of effective traffic.

(b) The exchanges which have already lived their lives are not replaced and thus require heavy maintenance effort.

(c) Lack of protective measures, such as cable ducting for external plant result in heavy-cable breakdowns.

(d) The long-distant network is inadequate even compared to the equipped capacity of the telephone exchanges.

The Indian Telephone network suffers from these maladies to a large extent.

The significance and importance of telecommunications as a vital component for national growth apparently was not recognised to the required degree even in the post independence period. Providing food, water, shelter, education has been the aim of planners so far. Telephone was considered almost as a luxury. Of late, however, there have been some indications of rethinking. Telecommunication now is being treated as an essential component of the infrastructure for national development.

To overcome the inadequacy of telecommunication service, planning from overall perspective of harmonious growth is essential. Not only the demand for telephone connection has to be met but sufficient thought is needed to provide reliable services to the satisfaction of subscribers. The challenge is multifaceted.

(i) meeting the present and anticipated demand for new telephone connections,

(ii) providing reliable long-distant telecommunication service commensurate with the number of telephone connections,

(iii) improving the quality of service by replacing the life expired exchanges and providing sufficient protective measures for external plant,

(iv) providing additional facilities particularly data transmission, point to point, and over-switched telephone network and through a data network in the later stages,

(v) provision of other facilities, such as facsimile service, Teletex, mobile telephone service etc.

Considering the lead time of the activities involved for attaining the above objectives, it is necessary to draw out plans at least for a decade rather than conventional five years period. The perspective plan for the years 1981-90 already prepared by Indian P & T Department has the following broad objectives.

(i) Provision of telecommunication service practically on demand,

(ii) Full automatisation of telephone exchange network,

(iii) Replacement of all life-expired exchanges and other equipments in the network as and when due,

(iv) Provision of subscribers' Trunk dialling facilities on integrated Trunk network between all cities and towns with a population of over 50,000,

(v) Extension of telephone services to within 5 km of most inhabited locations in the country,

(vi) Improving the quality and reliability of service taking advantage of emerging technologies.

Meeting these objectives would mean massive mobilisation of resources. The demand for new connections has been growing at the rate of 10% to 11% annually against the telephone growth rate of 6% to 7% leading to long accumulated waiting lists. To-day Indian P & T department serves over 2.6 million subscribers and still more than 0.7 million are in the waiting list. Year-wise demand projection for the coming years of decade is indicated in Table 3. It is anticipated that the total registered demand will rise to 7.25 million by 1990. In addition to providing the projected number of telephones by the end of decade, additional resources will be required to provide sufficient long distant network to cope up with the additional trunk traffic generated.

Coming to long-term planning, the exercise carried out by the P & T department indicates

TABLE 3 : Demand projection during the year 1984-90 (Telephone connections)

As on March 31 of	Anticipated demand (in lakhs)	% growth of demand	Target of wkg. connection	% growth of wkg. connection	Anticipated waiting list (in lakhs)
1984	36.73	12.00	29.84	12.86	6.89
1985	41.14	12.00	34.14	14.41	7.00
1986	46.07	12.00	39.14	14.50	6.93
1987	51.60	12.00	45.14	15.33	6.46
1988	58.79	12.00	52.64	16.61	6.15
1989	64.73	12.00	62.14	10.05	2.59
1990	72.50	12.00	76.64	15.29	0.86

that by the end of the century 26.4 millions telephone lines will be required. The population of India is expected to be around 955 millions and thus the telephone density if the target are achieved will be 2.77%. Of course, in the metro district where the major portion of demand is concentrated the telephone density would reach 20% as indicated in Table 4.

TABLE 4 : Telephone Density in year 2001

	Population in Millions	DELs in Millions	Telephones per 100
Metro Cities	50.73	10.11	20.00
Major Cities	47.10	6.59	14.00
Other Cities	70.22	4.21	6.00
Towns	118.56	4.20	3.50
Rural	668.76	1.33	0.2000
All India	955.37	26.44	2.77

Automatisation of the network is envisaged to be extending further by the time enabling full nationwide dialling throughout the country. Considerable amount of detailed planning, however, is still to be completed. Emphasis during the next two decade would continue to be on balanced plan and improvement on the quality of service. Efforts will also be made to catch up with the developed countries in providing sophisticated service leading to Integrated Services Digital Network.

Telecommunication in Calcutta

Even though the development of telecommunication in any country has to be primarily considered in terms of the complete national network, it is also necessary to evolve strategies for development for individual cities. This arises from the fact that each city has its own peculiarities and constraints. Calcutta is one of the most densly populated cities. At present, there are about two lakhs direct-exchange lines serving the population of about 10 millions. The telephone density is of the order of 2%. The projection of the requirement of telephones on a conservative estimate based on registered demand up to 1990 and 2000 are 3.3 lakhs and more than 6.5 lakhs. On the other hand, on the basis of exercise carried out in respect of demands projection at the national level, the demand for telephone in the metropolitan cities in the year 2000 A.D. is expected to be about 20 telephones per 100 population. This means that even, without taking into account any increase of population, Calcutta of the turn of the century would need some 2 million telephones. There are 47 telephone exchanges and quite a few of these need immediate replacement or replacement in the near future. By 1990, one lakh telephone lines exchange equipment will need to be replaced and by the end of the century almost all the exchanges except a very few which have been installed recently will need replacement. Thus, the planning task has become two-fold. The old exchanges will be phased out and will be replaced by new exchanges which will meet the demand for existing connections and of new subscribers. It has been estimated to meet the demand, 18 new exchanges will require to be installed by 1990. A number of sites will have to be acquired and buildings constructed for new exchanges. The task in respect of both planning and implementation is going to be formidable. It is also to be noted that these development works are intimately dependent on the development of civic facilities such as development of roads, water and electricity, building space etc. Remembering even the present shortage of underground space along the roads, one can visualise the magnitude of the problem if the underground cable network is to be enhanced by five or ten times its present size. Very special help and cooperation will be needed from the civic authorities in overcoming these constraints. At this point, it is also necessary to remember that adequate and efficient telecommunication facility is an important input for solving a number of problems confronting the civic authorities. Role of telecommunication in reducing the pressure of traffic on the roads is well known.

The emerging telecommunication technology of to-day offers several means to tackle the problems to a large extent. Digitalisation of telecommunication network is not only cost-effective but it can also be space-saving. Digital telephone exchanges of enhanced capacity can be installed in the existing exchange accommodation. The physical cable requirements of junction network can be cut down by introducing PCM and higher order digital multiflexing systems. The choice of the broad-band medium, viz. microwave, co-axial cable or optical fibres will, of course, vary from location to location. Digital microwave for telephone junctions, incidentally, is not new to Calcutta Telephone District. As regards the local-cables digital-electronic exchange, technology makes it possible to disperse the elements of exchange and thus reduce the requirements of local cables. The so-called remote line units can be installed in premises where concentration of subscribers exist. Thus, digitalisation of network both at internal and external plant levels is opening a new areas for planners to work upon. In Calcutta, by the turn of the century, the majority of exchanges will be based on digital technology and will offer a wide spectrum facilities which will include facsimile, data transmission as well. Digital-data links can also be switched through the exchange thus enabling, for example, access to digital computer from remote-data terminal just by dialling a pre-assigned number. This opens up huge possibilities hitherto beyond imagination. To improve the reliability of the service, ducting and pressurisation of cables has already been taken up for junction network. This will need to be extended to local cables also. The operation and maintenance of this huge telecommunication network will be a formidable task. Computerisation of some of the operations will help in providing efficient service. Very shortly it is planned to introduce computers for control of faults, keeping up-to-date cable and commercial records and for inventory control. The scope of directory enquiry system will be expanded to provide current directory information from various angles such as namewise, addresswise, address and categorywise, name and category-wise, etc. It has been planned to install computers in the four metro districts initially. Later, these computers will be interconnected and connected other computers of major districts for exchange of information. By 2000 A.D. it is envisaged that it will be possible to provide directory informations if not nation-wide but surely for most of the important cities.

By the turn of century, telecommunication will be required to play a much more important role in trade, commerce and other activities. There will be change in pattern of traffic. Enhanced transportation requirements and business activity will build up pressure on trunk network. Introduction of computer for commercial purposes will enhance the demand for long-distant data network. Satellite communication has opened up a new frontier for expanding the trunk network even to the remotest places which so far have been inaccessible.

Indian telecommunication is now at the beginning of crucial stage of transition to a much larger, more modern and more efficient system. The 'fundamental challenge namely, manifold quantitative expansion, adoption of new technology and progressive improvement of service can be met but it is essential that the necessary inputs are made available and telecommunication sector receives the priority denied to it earlier. ☐

SEMINAR ON CALCUTTA BEYOND 2000 A.D.

X. EMPLOYMENT

EMPLOYMENT PROBLEM IN CALCUTTA—A LOOK AHEAD

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UNEMPLOYMENT, in varying shades, has been a matter of concern not merely in developing countries but also in developed ones. Massive unemployment, as prevailing in India, is a reflection on the gap between plan and performance in the area of economic and social development, on economic imbalances and on uneven distribution of wealth. Future is not brighter and unless a major breakthrough is achieved in arresting population growth and/or in expanding the labour market, the turn of this century will find the nation in a mess.

With a population approaching the saturation level, an increasing proportion of females in the population and a more or less constant proportion of the population in the working age group of 15-59 years, Calcutta presents a dismal picture of employment trends and potentials. Percentages of the Calcutta population reported as 'workers' in the last four consecutive censuses appear in Table 1.

TABLE 1

Year	Percentage	of	Workers
	Male	Female	Total
1951	65.32	8.75	44.77
1961	61.40	6.08	40.41
1971	56.96	5.66	37.02
1981	55.28	6.35	34.93

Even in differences in the definition of a worker adopted during different censuses be taken into account, a consistently diminishing proportion of the male as well as the total population is clearly discernible. For the population as a whole a linear downward trend, as given by the equation

Y_t (estimated percentage of workers in year t) $=9.2825-1.6455\,t$

with origin as 1966 and unit as 5 years, gives the predicted percentage in 2001 A.D. as 32.24.

Estimated employment in the organised sector, which accounts for about one-fourth of the total working population as shown in Table 2, also shows a declining trend in the recent past, with a considerable drop from 1981 to 1982.

TABLE 2

	Estimated	Employment	
Year	Public Sector	Private Sector	Total
1980	5,08,082	3,06,887	8,14,969
1981	5,08,003	2,94,587	8,02,590
1982	4,98,463	2,29,099	7,27,562

It comes out that the contribution of the private sector to employment in the organised sector steadily decreased from 37.66% in 1980 to 31.49% in 1982. A breakdown of the organised sector employment according to industry groups (Table 3) reveals a shift from manufacturing to other industry groups particularly in the private sector. Percentage share of private manufacturing industries to the total employment in manufacturing stood at 75.39 in 1980, 74.27 in 1981 and 66.80 in 1982.

TABLE 3 : Employment in Manufacturing as percentage of Employment in Organised Sector

Year	Public	Private	Total
1980	13.80	69.97	34.95
1981	13.98	69.59	34.39
1982	14.38	62.95	29.67

The number of notified vacancies for jobs in Calcutta fell from 23,988 in 1971 to 12,565 in 1981. And these jobs are not exclusively meant for the people of Calcutta only. Against these vacancies 7,837 and 3,585 placements could be effected through employment exchanges.

As a sequal to the shrinking employment market in Calcutta, unemployed residents of Calcutta started searching for jobs elsewhere. Emigration for job search and placement on job is possibly one reason for the surprising diminution in the male population of Calcutta from 19,24,505 in 1971 to 19,22,632 in 1981, through the total population rose by 1,42,909 during the same period.

Judged in terms of the percentage of workers, Calcutta lags behind many of the cities in India particularly those situated in Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh etc.

The problem of unemployment in Calcutta, which is by and large the problem of unemployment among educated and skilled persons available for work, can not be easily solved without stabilising and expanding manufacturing industries in the state. On top of this, the unorganised sector has to be vigorously nurtured and the small organised sector will have to halt its move for concentrating more economic power at the cost of the unorganised masses. ☐

PROVISION OF EMPLOYMENT

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IT is rather difficult to prescribe remedy for eradication of unemployment problem in Calcutta of the present century. Unless the total national unemployment problem is solved, the problem of Calcutta will not be solved. Seventy per cent of the Indians live in villages, majority of them are dependent on agriculture and the rest depends on cottage industries and allied peripheries. Villagers are to be kept confined in villages with employment in villages to keep the pressure of influx of population to Urban area low.

Suggestions have been made in this communication with regard to eradication of unemployment problem of Calcutta and rural parts of Bengal only. Of course, if applied to other States, the problem can be arrested there also.

Calcutta was a prosperous village on the bank of the Ganges even in pre-Job Charnok era. Charnok turned the villages to the city of Calcutta. Importance of Calcutta is due to the following reasons :

(1) Calcutta was the capital of undivided India up to 1911 A. D.

(2) For geographical reasons, Calcutta is the largest port in North-East India.

(3) Calcutta is the centre of trade, industry and culture in North-East India.

(4) Calcutta has to bear an unlimited pressure of population mainly due

to partition of Bengal after the World War II when the world was merged in frustration and economic inequality.

Calcutta has attracted people from different parts of India for business and other services from long time past. West Bengal is over burdened with pressure of population for the flow of population from East Bengal. This problem is still alive. Social and natural environment have been affected. Economic equilibrium is lost. Most of the people live below the poverty line. West Bengal's rural industries are in deteriorated condition, though these were economic-base of rural Bengal. Unavailability of employment in villages has created pressure on Calcutta. So attention to total problem must be directed with an aim to eradicate the unemployment problem.

Agriculture

(1) The strength of population of West Bengal is at present 5.72 crore of which 10 million live in Calcutta. It appears from statistics that 64% is agricultural land, 13% is forest, 15% is Urban land and 7% is used as non-agricultural land. So attention to agriculture must accompany equal attention to allied subjects, as for example :

(i) *Rural electrification :* Only 25% of under ground water is being used which requires constant supply of electricity, other agricultural operations also require electricity. States which have made progress in agriculture have got better supply of electricity while in West Bengal only 16% of the Villages have been provided with electricity. This needs attention. Wind mills, on river banks or in wider fields should be installed. Scientists should take note of it.

(ii) *Irrigation :* Proper irrigation system is a must for agriculture. In addition to present river lift pumps, deep and shallow tube wells, attention to proper drainage of water in river-side areas should be made to avoid water stagnation. On the other hand, whenever there is shortage of water in canal area, the crop is affected. We require well composed irrigation system.

(iii) *Marketing :* Inspite of regulated price of crop of all cultivators do not get it due to absence of proper transport facilities. Fortytwo per cent of the villages do not have improved road within the distance of 2 km. Improved transport system is urgently needed. Only 22% of villages enjoy proper transport facilities.

(iv) *Supply of seed :* Good seed is one of the factors of good erop. The service of National Seeds Corporation needs more intensive utilisation to make West Bengal farmers independent of supply from other States.

(v) *Fertilizers :* Supply centres of fertilizers are situated in remote places. Use of organic fertilizers should also be encouraged. Supply of insecticides should be made convenient to the farmers who should know their proper use also.

(vi) *Better agricultural equipments* should be provided to the cultivators at cheaper cost. Attention to be given on local production of equipments.

(vii) *Co-operative :* Implementation of these recommendations which have so far been made by different committees, commissions regarding co-operation for betterment of agriculture should be made in the field of supply of equipments, agricultural credit, wire-housing of crops, marketing, etc. Care should be taken to protect the cultivators from the hands of middle man and unscrupulous businessman.

In order to have progressive cultivators, entomologists, economists, irrigation-engineers and fertilizer technologists should come forward. Such programme for agricultural development will require large number of educated and uneducated persons which, in turn, will provide larger scope for employment.

(2) *Animal husbandary :* For want of grazing ground, rural people are not in a position to keep cattle in their possession.

Therefore, rural uncultivatable lands should be converted into grazing grounds which will be useful for cattle and some people will have employment removing the want of milk and natural manure. Proper attention on biogas may create employment scope.

(3) *Digging of village tanks* : Action should be taken to dig the old tanks of villages by which developed pisiculture can be made. Moreover, the villages which do not have tanks should be provided with new tanks. On the banks of these tanks in accordance with climate and natural feature, horticulture, Poultry, Piggary and Diary can be installed. This should ensure food for fish and manure for the land.

(4) *Water-ways :* New water ways and wherever needful reconstructed water ways would make the business centre for all sorts of commodities better and would provide employment. It is to be noted petroleum crisis will take serious shape beyond 2000 A. D.

(5) *Canals* : If canals are taken from river through villages and they are made back to rivers, the effect of flood can be diminished because the water retention capacity of the river would be increased. On the other hand, the water of new canals would help irrigation. Embankments of these canals can be utilised for raising new forests which would protect the villages of erosion of soil. It would also increase the stock of fire-woods and would cease to destroy animals.

(6) *Forests* : While it is necessary for a country to have forest on 33% on its land, we have only 13% per cent. So new forests should be created with proper maintenance and protection. It would also create employment.

(7) *Cottage industry* : For creation of new employment possibility, decaying cottage industries should be taken into consideration with much care and attention without delay.

(8) *Scientific Organisation* : Every district should be provided with a scientific organisation which will look after the development and way of employment of its own. Preference should be given to the people of the soil of that area. Deteriorated condition of the village is one of the causes of the tendency of the educated people to leave their villages in search of better employment.

(9) *Cinema Industry* : Bengali Cinema Industry is on the verge of collapse due to its unavailability of its market outside the State. Villages may be provided with temporary structure for cinema show in every 5 km. Such programme will create employment opportunity for rural people and also save this industry.

(10) *Large Industries* : Large industries scattered over different districts of West Bengal should get more and more attention for the sake of improvement and development. These industries include Tea, Silk, Jute, Handloom, Woolen industry etc. If these industries are developed, then more people will be engaged in areas far from Calcutta.

Calcutta Metropolitan Development Authority (CMDA) is striving hard for betterment of Calcutta and different aspects of employment opportunities. On 16th February '83, in a symposium under the auspicious of CMDA, different points were discussed.

It has been told that large number of people will be engaged in various new industries to be installed before 2000 A. D. Such industrial programme should be undertaken in district town and suburbans. Government offices should also be shifted. A trend should develop for the establishment of new Government Offices in area, outside Calcutta. If facilities available in Calcutta can be provided to the industrialists in district towns, they will be encouraged to establish new industries their. This will somehow obstruct the flow of population to Calcutta.

In order to minimise population pressure on Calcutta and for larger employment, satellite cities like Howrah, Haldia, Siliguri, Kalyani, etc. should be properly developed. According to news daily, West Bengal now have 40 lakhs of unemployed people. If such a step is not taken, the unemployment problem will take a serious shape before the turn of this century. Moreover, this will create other social problems in serious shape.

To conclude, we can appeal to all administrators, intellectuals and people of every walk of life to do their best and to come forward with an earnest and honest effort to have a better country with happiest people under the sun having proper food, better clothing, true education and simple shelter. □

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PROGRAMMING ECONOMIC DEVELOPMENT FOR CALCUTTA METROPOLIS*

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THE terms "economic development" are used here with a narrow perspective indicating augmentation of income and employment of economically weaker section of the community so that the poorest of the poor could be taken out of the poverty line and are provided with the opportunity of having atleast two square meals a day. As per 1981 Census, more than 225 million people of India are living under poverty line while the corresponding figure for West Bengal and Calcutta Metropolis are 17.98 and 3.37 million respectively.

The Calcutta Metropolitan Area (CMA) cover a geographical area of 1350 sq km and a population of 10.2 million (1981 Census) which is estimated to be 15 million by the end of this Century. As per 1971 Census, the number of employed persons for CMA was estimated at 2.6 million with the respective percentage share of primary, secondary and tertiary sector being 1.91, 41.42 and 56.61 which indicates the predominance of tertiary sector. Relying on the NSSO Survey findings 1972-73 (27th Round) and with varying assumptions of labour absorption ratio between Calcutta Metropolitan Area and Rest of Urban West Bengal, it is estimated that in the year 2001 the available manpower resources of CMA (labour force seeking for jobs) would be ranging from 6.2 million to 8.3 million. It is most likely that the Calcutta Metropolis needs to absorb about 7.5 million labour force at the end of this Century to achieve full employment situation. With an optimistic assumption of uninterrupted positive growth trend, the working population for the metropolis has been estimated to be 3.9 million in 1986 and 5.9 million in 2001 A.D. thus leaving 1.6 million as unemployed labour force at the end of this Century. This additional labour force are to be taken care of for which a planned development approach and induced investment are needed. An attempt is made hereunder to suggest a development approach, keeping in view the immediate basic needs of hungry mouths of Calcutta Metropolis.

Development Strategy

The generation of economic activities is undisputably the only means to achieve the desired objective. Concentration of economic activities in the urban areas have been found to be the cause of rural-urban migration. Hence in pursuance of population dispersal policy future activity centres are to be located in less densely pockets. Moreover, inadequate autonomous private investments as against the growing needs of income and employment through decentralised economic activities and for that matter the Government needs to play a vital role. It is also imperative that prior to evolving any development strategy, the concerned target group needs to be clearly identified.

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* The opinions expressed herein this article are entirely those of the author and do not reflect views of the Authority where he is serving.

We have had enough of big talks of economic development, enough of econometric model building exercises and preparation of decorative reports. The need of the hour is to initiate an action-oriented need-based programme. In formulating action programme leading to income and employment generation, one has got to appreciate that private-sector-employment on large scale is a remote possibility because of industrial unrests, inadequate power supply, complicated trade licensing procedure, low profitability and hence capital outflow etc., while the prospect in the public sector is equally bleak thus leaving self-employment as the last resort to deal with the problem.

Philosophy of Development

The development strategy is to be evolved on the basis of a philosophy of development so as to make the target group gradually self-reliant and self-sufficient. The proverb that "Give a man a fish feed him for the day : teach a man to fish feed him for the life-time" should be the guiding principle in furmulating the development programme.

Self-employment Solution

The self-employment solution could be made effective by undertaking programmes designed to provide technical and financial assistance to small enterpreneurs both manufactures and traders of existing as well as proposed units of hetrogeneous character, at a liberal terms. Thus the suggested Programme is intended to introduce a rationalised credit operation mechanism for economically weaker section of the community, but distinctly different from charity. A state agency like CMDA, CIT, etc. would act as the coordinator of the programme and all the associated functionaries need to be placed under one roof over which the coordinating agency will have supreme control so that the necessary formalities for financing self-employment projects could be complied with easily and quickly. Novelties of the programme would be (i) bringing the bank services at the door of the applicant, (ii) helping the down trodden in his struggle for economic independence by transformation of his mere desire to a bankable proposition and (iii) arranging credit at liberal terms.

Presuming that techno-financial assistance could be made available to the small entrepreneurs through government and financial intermediaries, there are two major hurdles on the way of self-employment programme. These are absence of skills and marketing facilities. For the purpose of skill formation, a move has already been initiated by different quarters (government, voluntary agencies etc.) for setting up vocational training centres, though the available supply of the facility as yet is too small to satisfy the requirements. On the marketing front, the problem is more acute. A major share of Profit is eaten up by middlemen and the small enterpreneurs are forced to have recourse to distress sale. Hence, the arrangement for imparting training for skill formation and of marketing facilities should be a part of the long-term strategy.

From a case study (with average credit facility of Rs. 2000/-) under the small Scale Enterprise programme initiated by CMDA in 1979, as a pilot project, the output-capital ratio has been found to be sufficiently high leading to a considerable magnitude of surplus generation. This is a clear indication that programme of this nature is capable of achieving the desired objective. But for successful operation of such a self-employment programme, it is yet to strike a balance of the two apparently conflicting interests : banking business in one hand and credit facility at liberal terms satisfying welfare criteria on the other. They do not really quarrel with each other. A harmony can be achieved even within the existing system of credit operation with a marginal change. To maintain harmony and balance, the bankers should be prepared to liberalise the security aspects like mortgaging of valuables, collateral surety, etc., while they would be more interested to look into the integrity, technical competence of the borrowers and market viability of the products in question. A post-advance measure like the follow-up, monitoring and pursuation should be geared up vigorously so that repayments are assured within the time bound schedule.

Functional area

To materialise the objectives of income and employment generations a multi-directional approach is needed involving (i) promotion of small scale enterprises in new settlements, (ii) providing institutional facilities to selected area specific trade groups like tailoring in Metiaburuz, light engineering units in Bellilious Road, Clay Modelling at Kumartuly, tanners at east Calcutta, timber and plywood makers at Ultadanga and Beliaghata, etc., (iii) employment-generating schemes for slums, (iv) integrated Rural Development Programme for non-urban areas.

Operational Mechanism

Total project area is suggested to be divided into some bank-specific operational area and for each operational area one working unit may be set up each consisting of one technical expert from the associated bank and a social worker well acquainted with the concerned area. Each unit will provide necessary extension service to the prospective beneficiaries, make clients identification along with assessment of respective needs, transform the mere desires into bankable projects and ultimately forward the processed cases to concerned banks for disbursement.

The fund earmarked for the programme is suggested to be used as Revolving Fund so that the programme would become self-generating and self-financing. The found would be kept as fixed deposits in the operational branches of the banks those who will remain associated with the programme. The banks will continue to give loan from their own resources to small enterpreneurs who are duly recommended by the working unit operating in the respective area which is analogous to the present system of working of the SSE programme of CMDA. The only deviation to the present system is the consideration of fixed deposit in the operating banks. This will be a great impetus to the concerned branch managers of the banks who will sincerely try to push the programme towards success. This is because of twin factors : (i) Deposit mobilisation is one of the considerations to a branch manager with a considerable weightage. Hence, a declaration for a certain amount of deposit against the advances made under the programme would surely attract the branch managers and (ii) If there is a declaration that bad debts, if any, under the programme will be compensated fully and adjusted against the deposit then it will eliminate the fear psychosis of the branch manager of being questioned.

The deposit will act as caution money. The manager will no longer hesitate to make advances. But this success story of the programme will abviously depend on the cautious, judicious and efficient handling of the cases by the working units both in respect of processing and monitoring matters.

Capital costs and funding

It would become necessary to make direct funding for the following components from the fund earmarked for the programme : (i) A few Vocational Training-cum-Production Centres are to be set up for skill formation which are expected to be self-supporting in course of time but initial costs are to be met ; (ii) To facilitate marketing of the products produced by the entrepreneurs assisted under this programme, a few sales Emporium are to be set up for which initial requirement are to be met from the fund while these will be self-financing ultimately ; (iii) Some area specific trade-groups need some help which are common in character and hence private investment is a remote possibility. For instance, construction of a Marketing complex with godown facilities at Metiaburuz is likely to reduce the number of distress-sale of readymade garments produced by the local tailors. Similarly, the space constraint of the plywood manufacturing units along the canal of Manicktola-Beliaghata area (in respect of drying purposes) can be eliminated by the installation of a few mechanical dryers. This facilities of these nature are to be provided from the Fund to help the industries concerned; (iv) The organisation like Khadi and Village Industries Commission (KVIC) may be invited to join the programme. The physical infrastructure cost component for implementing the schemes of the commission may be financed if required from the fund; (v) Under Integrated Rural Development Programme, Primary sector employments like pisciculture, poultry, diary etc. are to be encouraged and for that purpose necessary infrastructure (like construction cost of office-room for a cooperation etc.) cost will have to be born. The benefits of special Animal Husbandry programme, Government of West Bengal, are to be brought to the target group and associated infrastructure costs, if needed, to be made available from the fund.

Concluding Remarks

(i) The total geographical coverage at a time is a huge task. Hence, the programme could be effectively implemented through the formation of a few nucleus scattered over the area.

(ii) As the client group belong to economically weaker section of the community, they do not have valuables to offer as security for their advances, nor do they find suitable collateral surety to stand as guarantor. Thus to ensure recovery of loan, the social guarantee is perhaps the last resort and this could be made effective with the induction of area-based voluntary organisations within the purview of the programme.

(iii) In formulating development-strategy, economic development programme needs to be integrated with physical development.

(iv) Desired diversion from prevailing development approach is towards decentralisation of economic activities making the programme self-financing and self-generating and motivating target group to appreciate the dignity of labour and the value of self-help and self-reliance.

(v) The upliftment of the economically weaker section of the community could not be made in isolation but it is associated with a general growth of the economy as a whole. In revamping the economy of Calcutta metropolis in general, it is necessary amongst other: (a) to encourage self-help programme, (b) to review the industrial policy banning industrial development in metropolitan area, (c) to extend the benefits of Incentives Scheme to the small entrepreneur within the slums of metropolitan Calcutta, (d) to introduce Integrated Rural Development Programme in rural pockets, (e) to set up agro-based industries in the periphery of CMA (which is also capable of reducing the number of rural-urban migrants), (f) to provide necessary physical infrastructural support to the Calcutta port and (g) to develop few commercial centres within the Calcutta Metropolitan Area.

(vi) Above all, planners, politicians and bureaucrats will have to work hand in hand to solve the problem. The need of the hour is to see that the Plato's theory of Justice (work assignment according to ability and specialisation) is followed unconditionally. The sooner the need is appreciated, the better for the country.

LETTERS TO THE EDITOR

A new host of *Cnaphalocrocis medinalis* Guen'ee

The rice-leaf folder, *Cnaphalocrocis medinalis* Guen'ee (Lepidoptera : Pyralidae) attacks various grasses, sedges, and some cultivated crops in South and South-East Asia. This pyraustid feeds on rice, maize, sugarcane, millets, wheat and Sorghum in the Philippines[1]. Sakai *et al*[2]. in Japan and Sison[3] in the Philippines mentioned that this insect feed both on rice and other grasses.

During December 1983, a heavy attack of *C. medinalis* was observed in fields particularly on two- to three-border rows of newly-transplanted rice seedlings of IR 54 and C1000 at Victoria, Laguna, Philippines. On closer examination of the bunds, it was observed that caterpillars of *C. medinalis* were found feeding inside the rolled leaves of the grass, *Leersia hexandra* Swartz. In general, one caterpillar was found in each folded leaf. Sometimes, however, up to 2-3 caterpillar per leaf were counted. In most cases, the leaf folds found to be moist at the lower open end, were found to have the caterpillar. Large numbers of caterpillars from the *L. hexandra* and rice were collected and on rearing separately in laboratory, the caterpillars feeding on *L. hexandra* and rice readily accepted paddy leaves and vice versa. It was interesting to find that the pest was *C. medinalis* in both cases. The identity of the moth was confirmed by Mr. A.T. Barrion, Entomology Division, International Rice Research Institute, Philippines.

This report of *L. hexandra*, as an alternate host of *C. medinalis* appears to be the first confirmed record in the Philippines.

It is suggested that prior to transplanting of rice in the main season, spraying of bunds, which harbour large populations of larvae of this pest on *L. hexandra* may be done. This will reduce further multiplication and prevent migration into rice as soon as the crop is planted.

Further studies on this insect with reference to natural enemies, carry over from *L. hexandra* to rice are in progress and a more detailed account will be published at a later date.

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Cultural and nutritional variabilities among five isolates of *Colletotrichum capsici*

Variation in fungi is a common phenomenon and it is important in *C. capsici*, the incitant of die-back and not fruit-root of chilli. Studies on variation are pre-requisites for evolving a new variety resistant to disease. Many new varieties of chilli evolved, lose their resistance after some years of extensive cultivation due to appearance of new races in nature. Hence, it is important to know the relative number and distribution which will be helpful in evolving varieties against existing races. Therefore, a comparative study was undertaken to determine variations, if any, among the isolates of *C. capsici*.

Monosporic isolates of *C. capsici* were established from affected seeds as well as chilli plants collected from different parts of India and designated as isolate 1, 2, 3, 4 and 5. Pathogenicity of all the five isolates was established by inoculating 60-day old plants and red-ripe fruits.

In order to study the growth rate and cultural characters of each isolate, sterilized potato-dextrose agar medium in petri-plates was inoculated with each isolate separately and incubated at 28°C for 7 days. Linear growth and cultural characters of each isolate were noted after incubation period.

Variation in growth and sporulation among the five isolates on various sources of carbon and nitrogen was studied by incorporating carbon and nitrogen compounds separately in basal Richard's medium (free of carbon or nitrogen) at the same level as present in the basal medium. The pH of the medium was adjusted to 6.0. Twentyfive ml of medium, thus prepared was pipetted out of 100 ml. Erlenmeyer flasks, plugged with non-absorbent cotton and autoclaved at 10 lb pressure p.s.i. for 20 min. The media were then inoculated and incubated at 28°C for 21 days. After incubation period, the mycelial mats were filtered, dried and finally weighed. The estimation of sporulation was done with the help of haemocytometer. In each case, three replications were taken, average of which is presented in Tables 2-3.

Table 1 reveals that isolate 1 attained maximum growth in 7 days followed by isolates 4, 2, 5 and 3. Growth was faster in isolate 1 than other isolates. Sporulation in isolates 1, 2 and 4 was abundant, whereas it was moderate in isolates 3 and 5. Colony characters of all the five isolates were as follows :

Morphological characteristics	Isolates of *Colletotrichum capsici*				
	1	2	3	4	5
Mycelium	Colony circular, margin zigzag, aerial but thin, greyish in colour	Colony circular, margin smooth and entire, cottony, fluffy, loose, white to dull grey in colour	Colony circular, margin smooth and entire, aerial in early stage but submerged in later stage, whitish in colour	Colony circular, margin smooth and undulating, fluffy, loose, whitish grey in colour	Colony circular, margin smooth and entire, loose, dirty white in colour
Acervuli	Light brown in colour	Violet brown to deep brown in colour	Deep brown in colour	Dark black in colour	Light black in colour
Conidia	Pinkish in colour and abundant in number, fusoid	Hyaline and abundant in number with narrow ends	Hyaline and moderate in number with narrow ends	Pinkish in colour and abundant in number with blunt ends	Hyaline and moderate in number with narrow ends
Setae	Dark brown in colour with light brown tips, thick-walled	Dark brown in colour with light brown tips, thin-walled	Dark brown in colour with paler tips, thick-walled	Deep pale in colour with light pale tips, thick-walled	Dark brown in colour with light brown tips, thin-walled

TABLE 1 : Growth and sporulation of isolates 1-5 of *C. capsici* on potato dextrose agar medium

Isolates	Linear growth (mm) after hours							Sporulation
	24	48	72	96	120	144	168	
1	16.0	32.4	46.3	60.2	70.4	78.2	86.6	Abundant
2	8.5	17.6	26.5	34.6	41.8	49.2	56.4	Abundant
3	0.0	8.9	17.7	26.6	33.8	41.4	49.7	Moderate
4	14.3	26.1	38.6	48.8	58.6	66 0	74.5	Abundant
5	4.5	14.3	24.4	33.6	41.6	49.5	53.8	Moderate

TABLE 2 : Growth and sporulation of isolates 1-5 of *C. capsici* on different carbon sources

Carbon source	Dry mycelial weight (mg)					Sporulation (1000/ml)				
	1	2	3	4	5	1	2	3	4	5
Arabinose	280.0	195.6	106.4	240.5	180.5	23.4	16.7	14.8	23.0	11.8
Rhamnose	307.8	217.4	207.6	300.5	241.6	23.9	16.8	14.8	22.6	12.8
Glucose	320.4	209.8	247.8	305.8	195.8	22.9	18.2	15.7	21.6	24.8
Mannose	301.8	241.2	209.4	312.9	337.8	19.2	12.2	10.9	18.3	13.9
Sucrose	380.8	280.5	304.6	345.8	251.9	20.8	14.9	10.9	20.0	10.3
Lactose	319.0	265.4	201.3	380.4	241.7	26.9	29.7	16.2	24.9	20.8
Maltose	270.9	201.1	237.4	245.4	221.2	27.0	20.2	18.3	26.0	21.4
Raffinose	207.8	165.8	183.7	231.4	101.2	16.9	8.2	9.1	15.4	5.8
Starch	107.8	70.3	81.4	141.2	96.7	11.8	6.2	8.1	14.1	5.1
Mannitol	117.3	61.2	80.4	101.8	89.4	21.9	9.8	9.2	24.4	6.8
Xylose	200.8	299.4	161.6	211.8	180.2	26.8	17.9	19.2	25.1	16.8
Control	71.2	60.4	49.2	80.6	33.6	0.0	0.0	0.0	0.0	0.0

Average of 3 replications

TABLE 3 : Growth and sporulation of isolates I-5 of *C. capsici* on different nitrogen sources

Nitrogen source	Dry mycelial weight (mg)					Sporulation (1000/ml)				
	1	2	3	4	5	1	2	3	4	5
Urea	290.5	230.6	260.3	375.6	201.6	22.2	17.2	18.8	20.4	13.5
Peptone	311.6	390.5	201.8	330.5	285.3	20.2	18.2	12.3	22.1	18.7
Potassium nitrate	299.5	202.6	361.4	280.8	239.4	21.2	14.3	12.2	19.5	11.4
Calcium nitrate	267.5	241.2	208.4	291.5	231.6	18.3	14.1	11.2	19.2	9.9
Ammonium nitrate	248.5	185.4	151.9	221.7	205.6	26.7	16.4	13.2	23.7	13.4
Sodium nitrate	281.2	209.4	231.9	296.4	241.9	22.3	16.4	14.8	23.4	13.2
Asparagine	381.6	305.8	268.7	320.8	340.9	27.2	21.6	16.4	21.0	18.1
Ammonium sulphate	131.6	81.8	100.3	160.6	60.9	11.8	5.8	3.4	10.3	5.1
Sodium nitrite	161.2	120.3	89.7	170.9	69.6	18.2	13.2	14.4	19.2	12.2
Calcium nitrite	140.9	71.2	105.6	161.4	89.3	17.6	11.2	12.1	15.9	10.1
Ammonium Chloride	129.6	107.5	69.8	187.8	90.6	9.6	5.6	3.5	7.1	3.0
Ammonium phosphate	251.2	169.8	120.4	265.8	157.6	25.2	16.3	13.4	23.5	12.2
Control	41.3	31.2	20.9	90.6	60.8	3.1	0.6	2.0	2.5	1.4

Average of 3 replications

Table 2 shows that maximum growth of isolates 1 and 3 was obtained with sucrose, isolate 2 with xylose, isolate 4 with lactose, whereas isolate 5 grew best on mannose. Growth of all the five isolates was poor on starch and mannitol. Sporulation in isolates 1 and 4 was maximum with maltose, whereas isolate 2 with lactose, isolate 3 with xylose and isolate 5 with glucose. Thus, the extent of growth and sporulation of all the five isolates varied from one another on the same as well as on the different sources of carbon. Thind and Randhawa[6] found the best growth with dextrose, whereas maximum sporulation was obtained with pectin. Agnihorti[1] found glycerol as the best source of carbon for growth. Sahni *et al.*[5] recorded maximum growth with raffinose. Thus, these findings do not agree with present findings which may be accounted for the difference in the races of the fungus under study.

Table 3 indicates that there seems to be great variation among all the five isolates in utilization of nitrogen sources for their growth and sporulation. Isolates 1 and 5 recorded the highest mycelial output with asparagine, whereas isolate 2 with peptone, isolate 3 with potassium nitrate and isolate 4 with urea. Maximum sporulation in isolates 1 and 2 was obtained with asparagine, whereas isolate 3 with urea, isolate 4 with ammonium nitrate and isolate 5 with peptone. Thind and Randhawa[6] found the best growth on alanine and best sporulation on leucine. Agnihorti[1] recorded maximum growth on ammonium sulphate. Chaturvedi[2] found glutamic acid as the best source of nitrogen for growth. This shows that the isolates under study are quite different from other isolates[1-3,6].

Thus, all the five isolates under study, varied differently in relation to virulence, growth characters and nutritional behaviour and thus they can be assigned as different physiological races as Peterson and Katznelson[4] and Edgington and Walker[3] pointed out that physiological and nutritional variatilities do serve as aids in differentiation of distinct races.

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Development of more rhizobial population in the inoculum and its effect on *Cicer arietinum* L.

It is a proven fact that the agricultural economy depends more extensively on biological N_2 fixation, a process which derives its energy from the sun[1]. The pulses are a good source of protein specially in the vegetarian diet and constitute an essential item of dietry all over India[2]. Its low availability may lead to malnutrition among the vegetarian Indians. Therefore, several attempts have been made to increase its production. The objective of the present investigation is the same.

The present studies are the part of commercial culture production of rabi season during 1981. During total production period of 4½ months, three lots (each lot of 5,000 culture plots), i.e. initial, middle and last were selected for the purpose. The interval among the each lot was 45 days. Each lot was impregnated with the broth of Cicer rhizobia (252×10^8 viable cells/ml of broth). In each lot, three proportions of broth and lignite viz., 40 : 100 ; 60 : 100 and 80 : 100 were used (named as 1.0 ; 1.5 and 2.0 fold-broth concentrations). But in latter two concentrations, 40% moisture was maintained at the time of packing by keeping the impregnated lignite in the curing room, for a comparatively longer time maintaining the fineness of the powder. In this way three treatments were done from each lot, and a total of nine treatments were framed from the three lots. Sowing of the experiments was carried out at the completion of last lot, meanwhile initial and middle lot samples were kept stored at a temperature of 15-20°. Rhizobial population of each lot was determined at the time of sowing (Table 1).

The greenhouse studies were carried out in 5 kg-earthen pots with 5 plants per pot in the Department's greenhouse while field experiments were conducted in 1.2×3.0 metres plots at agricultural research farm of JNKVV, Jabalpur. In both the experiments, Bengal-gram variety H-208 was sown. The treatments were replicated four times in R. B. D. with the basal dressing of N, P, K @ 10-40-0 kg/ha.

Nodulation study was done after 45 days of sowing by uprooting five plants from each pot and plot. The crop was harvested at maturity.

Table 1 reveals that in pot experiments, nodule number did not differ significantly while in the field experiment, 1.0- and 1.5-fold broth concentrations in initial lot and

TABLE 1 : Extent of broth concentration in bacterial inoculum and its effect on *Cicer arietinum*

Treatment	Initial count of the culture at the time of sowing ($X \times 10^7$/gm)	Pot experiment			Field experiment		
		Nodule No./5 plants	ODW of nodules/5 plants (mgm)	Grain in yield (gm/pot)	Nodule No./5 plants	ODW of nodules/5 plants (mgm)	Grain yield (q/ha)
Control	—	114	196.00	2.00	31	122.50	22.79
Initial lot, 1.0 fold broth	60	131	225.50*	2.66	40*	174.00*	21.67
Initial lot, 1.5 fold broth	70	120	157.50	2.36	43*	197.75*	22.83
Initial lot, 2.0 fold broth	190	136	235.00*	3.73*	28	211.75*	24.77*
Middle lot, 1.0 fold broth	30	120	155.00	2.50	34	198.00*	24.53*
Middle lot, 1.5 fold broth	70	120	214.20	3.07*	25	74.75	23.07
Middle lot, 2.0 fold broth	160	130	179.20	2.59	47*	204.25*	24.39
Last lot, 1.0 fold broth	30	148	178.50	3.13*	24	126.25	23.20
Last lot, 1.5 fold broth	450	129	177.70	3.14*	25	125.75	22.92
Last lot, 2.0 fold broth	650	114	227.00*	2.84*	39*	166.25*	24.43
C. D. at 5%	—	NS	25.03	0.88	8.45	37.58	1.73
C. V.%	—	—	9.04	22.0	17.27	16.18	5.09
Overall performance	1.0	16%	—	38%	3%	35%	1%
	1.5	7%	—	42%	—	8%	0.6%
	2.0	10%	9%	52%	22%	58%	7%

* Statistically significant

2.0-fold broth concentration in middle and last lots increased the nodule number significantly over uninoculated control. Oven-dry weight of nodules was significantly increased by 1.0-fold and 2.0-fold broth of initial lot and 2.0-fold broth of the last lot in pot experiment but in field experiment initial lot increased the nodular mass signifiactly over control among all the concentrations of broth. In middle lot, it was increased significantly by 1.0- and 2.0-fold broth concentrations while in the last lot only 2.0-fold broth concentrations increased the oven dry weight significantly.

Grain yield was increased significantly in 2.0-fold of initial lot; 1.5 fold of middle and last lots and 1.0-fold of last lot in pot experiment. In field experiment, 2.0-fold broth concentration of initial lot and 1.0-fold of middle lot increased the grain yield significantly over uninoculated control. But when over-all response of broth concentrations among three lots were considered, it was observed that 2.0-fold broth concentrations gave the maximum yield in pot and field experiments i.e., 52% and 7% respectively, which may be due to increased rhizobial population. Thus, mixing of inoculated broth in double dose with carrier can boost the crop yield upto a certain extent.

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Algalization of guava orchards : Comparative study

About 414 ha of uncared guava orchards exist on low-lying and water-logged soils in subtropical parts of Jammu and Kathua districts of J & K*. Water-logging resorts to anaerobic condition which is congenial for blue-green algae. Kerni *et al.*[1] observed that algalization of one-year old guava seedlings resulted in increased growth parameters with nitrogen-sparing effect equivalent to 12.5 g per seedling. The present comparative study undertaken during 1979-81 at fruit plant nursery Maralia and Udheywalla (Jammu), was aimed as assessing algal effect on the yield of guava plants and improving upon the fertility status of soil so as to benefit the farming orchardists.

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*Official figures obtained from the Dy. Directorate of Horticulture, Jammu province, J & K.

Five, more than ten-year old, guava plants of uniform size were selected per treatment replicated thrice in a simple-randomized block layout. During preparatory tillage, 128 g of phosphorus and 80 g of potash were supplied to each plant under trial by trench method. Soil-based mixed culture of nitrogen-fixing blue-green algae (*Anabaena, Nostoc, Plectonema, Tolypothrix, Aulosira*) received from I. A. R. I., New Delhi, was multiplied at this Research Station and inoculum spread uniformely @ 5 kg per treatment in standing water in plots for algal treatment. Treated plots were separated from control by making compact bunds (30 × 30 cm). Identical cultural and plant-protection schedules were adopted during the trial period (April to December). Chlorophyll content of guava leaves was determined before start and at the end of trial, using methods given by Ranganna[2]. Fruit yield and chlorophyll content are given in Table 1.

Results indicate that algal-treated plots showed 20.66% and 29.72% increase in chlorophyll content of leaves and fruit yield respectively over the control due to creation of elemental nitrogen and growth-promoting factors elaborated by blue-green algae[3]. Algalization may help in rejuvenating uncared guava orchards in water-logged soils of Jammu & Kashmir.

TABLE 1 : Chlorophyll content of leaves and fruit yield of guava as influenced by algal treatment

Treatment	% chlorophyll content of leaves								% increase over control	Fruit yield (Qt)				% increase over Control
	1979		1980		1981		Mean							
	Before	After	Before	After	Before	After	Before	After		1979	1980	1981	Mean	
Algal treated	4.37	4.61	3.84	4.59	5.45	7.27	4.55	5.49	20.66	3.84	1.46	5.85	3.71	29.72
Control	4.37	3.74	3.84	4.23	5.45	5.50	—	—		3.29	1.40	3.90	2.86	

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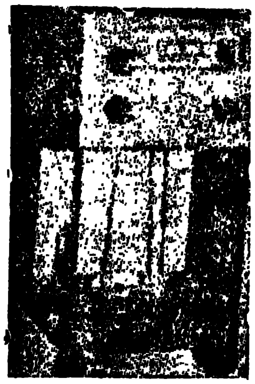

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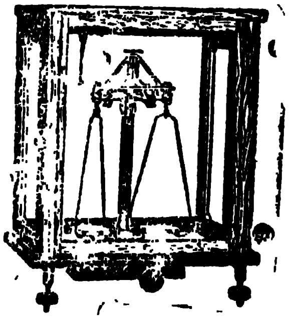

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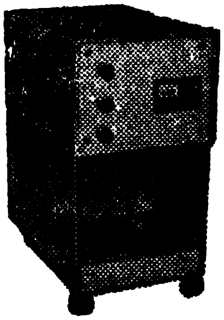

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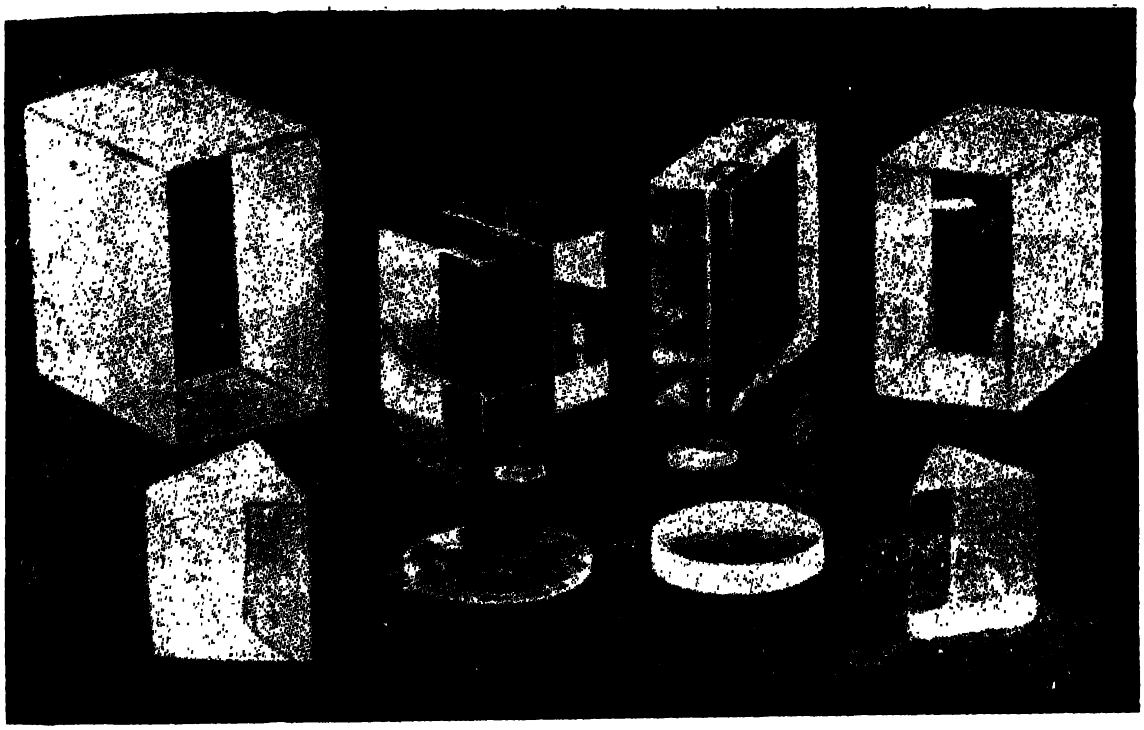

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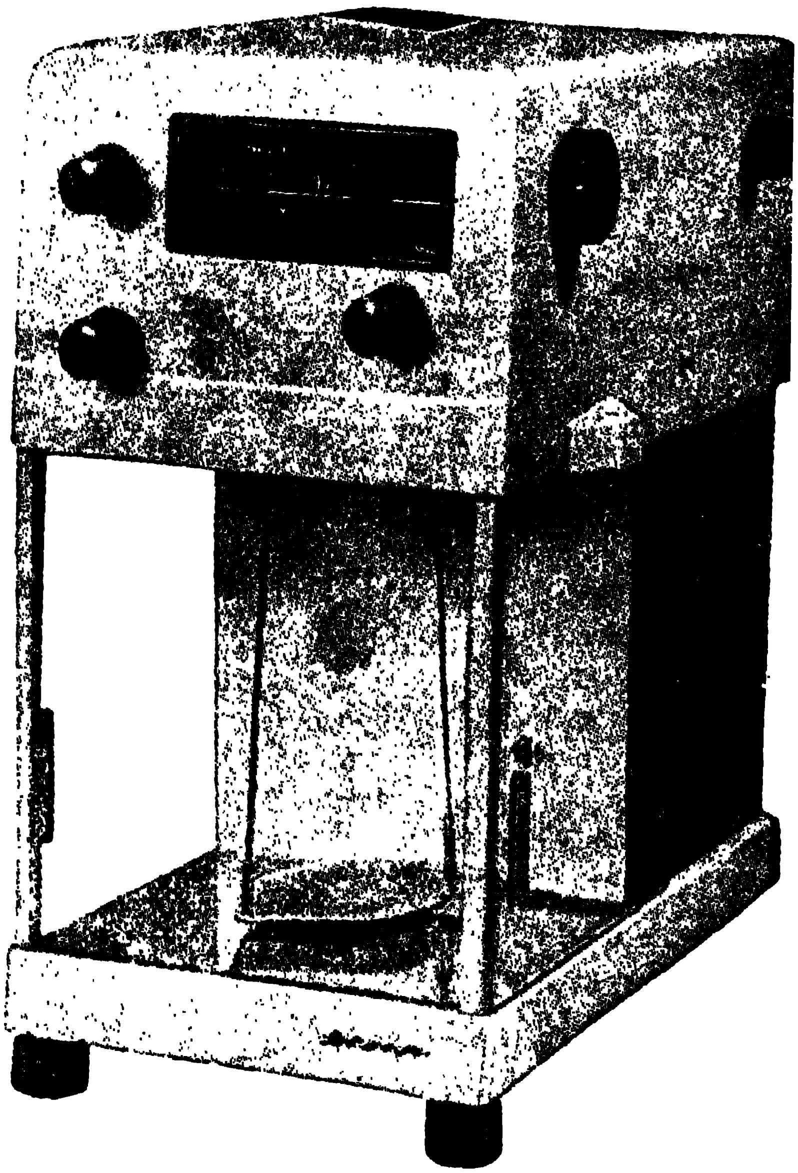

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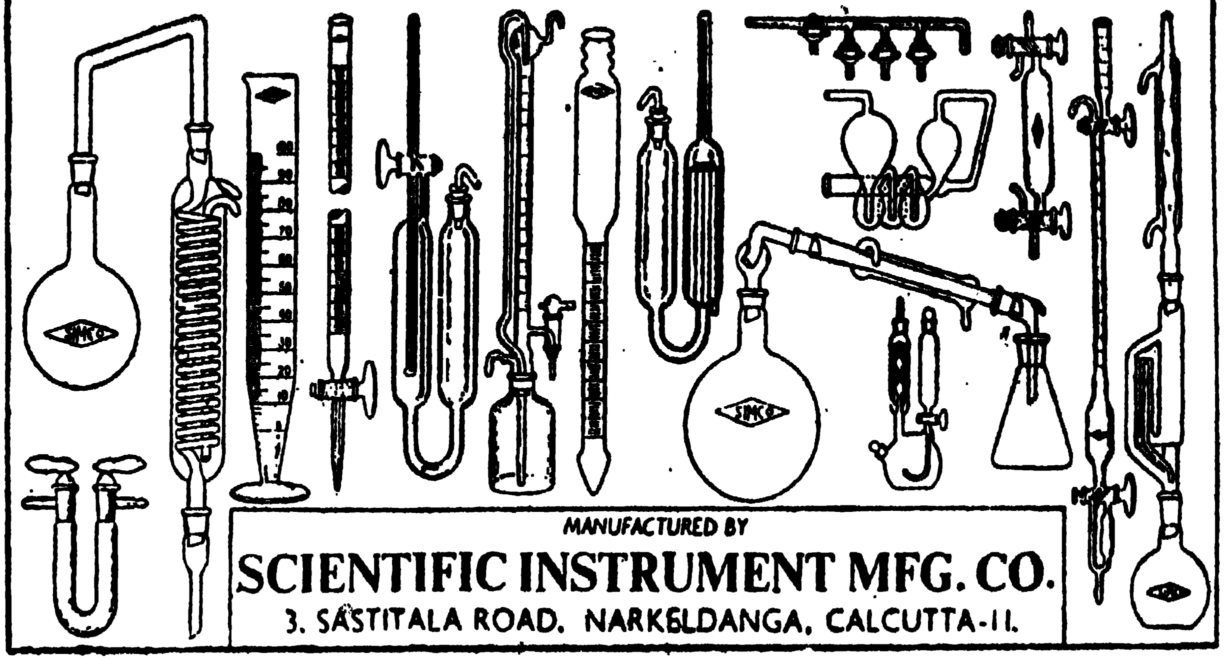

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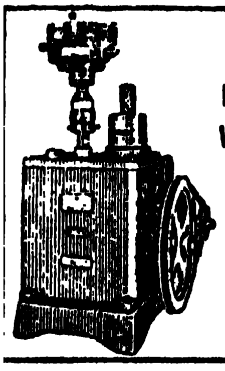

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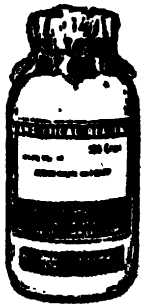

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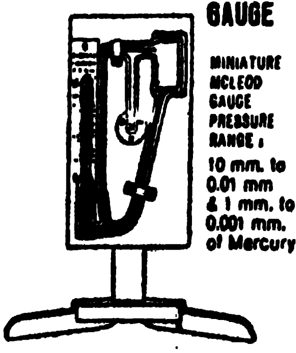

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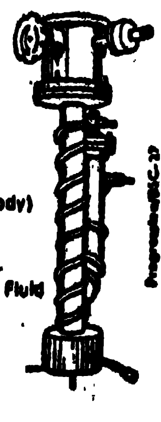

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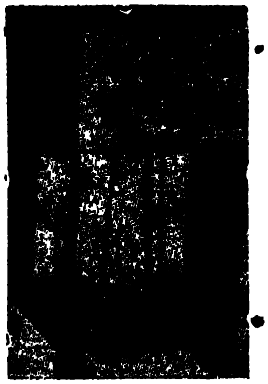

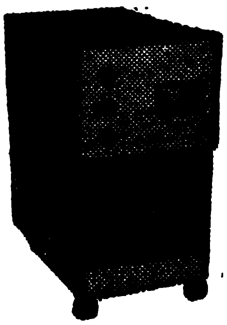

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SCIENCE & CULTURE

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HOMAGE TO SRIMATI INDIRA GANDHI

WE pay our homage to the departed Prime Minister, Srimati Indira Gandhi whose assassination has been a shock to the entire nation. The scientific community has particular reason to be mourning her loss because she had not only carried on the scientific policy of the Nehru era but also extended it to new areas. She believed in the liberating influence of science, and saw it as an ally of social justice.

Science has been recognised as a pursuit of knowledge for its own sake, technological inventions have used the fruits of that wisdom to the material needs of our civilisation. In the last few hundred years their impact on society has been formidable, and as we stand on the door-steps of the 21st century, science and technology seem to dominate the way we live, work and think. A new relationship has also emerged between science and the people at the helm of political affairs. A head of government now has the power to encourage or hinder the free development of science in a way unimaginable during the time of J. C. Bose and P. C. Ray.

As late comers in the race, our future depended a great deal on the right kind of decisions taken at the early stage when our science and planning policies were being formulated. Fortunately the initial thurst was towards a rational point of view. Nehru even when he was vaguely thinking about the future could instinctively feel that 'India must lessen her religiosity and turn to Science'. Later the concept of national planning grew, much of it in the pages of this journal, led by the late Professor Meghnad Saha. However, Nehru's faith in science was evident in the Scientific Policy Resolution of 1958, which became a kind of national charter for our scientists. To produce worth-while results the goal has to be clear-cut. Thanks to the early beginning in the right direction, we now have a significant scientific infrastructure in terms of number, range of skill and quality.

Nehru did not live to see India being recognised as a nuclear country or entering the space age. When Mrs. Gandhi came to the scene we were ready for more ambitious ventures—like exploring the deep ocean-bed, exploring the south pole, putting up multi-purpose satellites, even sending a man into space. The spectacular event of viewing Rakesh Sharma talking to the Prime Minister from outer space had a tremendous psychological impact on the younger people.

Mrs. Gandhi's Technology Policy Statement of 1983 made it very clear that for a country of our size and endowments, self-reliance is inescapable. It laid emphasis on attaining technological competence, particularly in strategic and critical areas, making the maximum use of indigenous resources. She reminded the delegates at the Tirupati session of the Indian Science Congress of the famous words of Le Corbusier: "There is no such thing as a primitive man; there are only primitive means". To the question of whether we can afford new techniques like micro-computers she said—"can we afford to be stuck with obsolete ones ?" She agreed with many experts that village mini computerisation should be given the highest priority.

Mrs. Gandhi had been called a pragmatist. But she was also capable of evolving a philosophy which linked the present with the future on the one hand and with the past on the other. Her well known speech at the Stockholm conference of the United Nations bears testimony to this :

"Must there be a conflict between technology and a truly better world or between enlightenment of the spirit and a higher standard of living ? Foreigners sometimes ask a very strange question, whether progress in India would not mean a diminishing of her spirituality or her values. Is spiritual quality so superficial as to be dependent upon the lack of material comfort ?"

Talking of pollution in the same speech she focussed the peculiar dilemma of the Third World countries. The rich nations look condescendingly at our continuing poverty. They also warn us against their methods. We have no intention of degrading our environment any further, yet the grim poverty of a large number of people stares us in the face. "Unless we are in a position to provide employment and purchasing power for the daily necessities of the tribal people and those who live in or around our jungles, we cannot prevent them from combing the forest for food and livelihood, from poaching and from despoiling the vegetation When they themselves feel deprived, how can we urge the preservation of animals. The environment cannot be improved in conditions of poverty. Nor can poverty be eradicated without the use of science and technology".

With the tragic and sudden end to a life so sympathetic to the cause of science—the entire scientific community in this country has lost a friend and patron. □

Santimay Chatterjee

FUTURE APPROACHES TOWARDS INTEGRATED MANAGEMENT OF PESTS IN DRYLANDS

N. C. JOSHI* and N. K. SANGHI**

IN the present paper, the term pest management has been taken into its wider sense which refers to the control of weeds insects as well as diseases. The magnitude of damage due to these pests is well known and has been amply quantified[1-2]. Similarly, the salient findings which emerged out of the work carried out in the dryland project and elsewhere have also been sufficiently documented[3-4]. Attempts have been made to bring out some of the reactions of farmers to the above recommendations in order to identify the priority areas for future research.

Management of Weeds

During the last decade sufficient research information has been generated on the mechanical as well as chemical methods of weed control particularly for the annual weeds of *kharif* season crops. It was clearly established that the first weeding operation *must* be carried out as early as possible after the sowing (i.e. at about 20-25 days stage in case of cereals having 90-100 days duration). By and large, this recommendation has been well appreciated by the farmers. However, the mechanical weeding approach could not satisfactorily meet the problem in situation where the labour is busy with alternate jobs and also where the field is too wet due to continuous rains and heavy soils. The following examples would illustrate the point.

(a) In the red soils of Telengana region, very little attention is paid to drylands particularly in villages where irrigation intensity is more than 10 per cent. During *kharif* season, the farmers are heavily occupied for field operations in irrigated paddy crop. The improved dryland technology in such situations did not attract the farmers' attention primarily because of the clash for labour demand between hand weeding in drylands and transplanting in paddy.

(b) In the uplands of Orissa, Bhubaneswar, etc. the weeds are controlled through the use of only hand tools. Traditionally, only one operation is done by the farmers. The improved technology with dwarf genotype and fertilizer use could spread only in a limited area because of its requirement of additional weeding operation. The system of line-sowing (which is meant to minimise the labour requirement for weeding) could not attract the farmers' attention due to practical difficulties at sowing time (since a very little time is available for sowing operation due to continuous rains).

(c) In the wet vertisols of Madhya Pradesh, Maharastra and Andhra Pradesh, a large percentage of area is kept fallow during kharif season. The trails have consistantly proved that under the improved management, it is highly advantageous to take a kharif crop in these lands rather than fallowing. However, the attempts to introduce the new technology in these lands met with only a partial success. In many years, the clear days for weeding operations during July August are very limited with the result many farmers are forced to keep a sizeable area under fallow inspite of the fact that they are convinced about the need for raising the crops during *kharif* season.

The mechanical weeding approach has also shown its limitation in situations where perennial weeds are severe. Traditionally, deep ploughing during summer season has been the usual practice, otherwise, these weeds are required to be controlled through a repeated shallow tillage (by keeping the land fallow during kharif season). Both of these existing approaches have their own limitations. Deep ploughing is practised mainly in cases where the farmer owns bigger holdings and therefore, possess his own 'heavy duty bullocks'. Similarly, the kharif fallowing approach, though controls the weeds, suffers due to low productivity and inefficient use of rain water.

---

*Central Plant Protection Training Institute, Hyderabad.

**All India Coordinated Research Project for Dryland Agriculture, Hyderabad.

The above examples illustrate that there is a need to introduce herbicide approach at least in selected situations. Although a lot of information is already generated, the following points may be considered for further refinement of the herbicide technology.

(a) In majority of cases, the herbicides are required to be applied around the sowing time From the practical view point, it may be better if suitable herbicides are identified which can be applied in the standing crop at about 3-4 weeks stage [as in case of 2, 4-D and Isoproturon (N, N-Dimethyl-N-4-isopropyl-phenyl urea) in wheat]. Such a method would provide high flexibility to the farmer so that he may use either herbicide or mechanical measure, depending on the seasonal conditions or the labour availability.

(b) Most of the presently available herbicides are required to be applied through high-volume sprayers which lead to practical difficulties with regard to the availability of water as well as labour at the time of sowing operation. It may be useful if suitable nozzels of spray and appropriate formulations of herbicides are identified and developed, so that they can be used with low volume sprayers. The granular formulations of the herbicide would further be helpful if they can be applied with the last ploughing operation. The practice of broadcasting the mixture of herbicide and sand (as being currently followed by the farmers of Haryana and Punjab for the control of weed in wheat crop) need also be evaluated and refined.

(c) In many cases, the herbicides are required to be incorporated in soil before sowing operation. The trials, which have been conducted at the research stations, have usually used the implements like disc harrow, rotavator, etc. for efficient incorporation. Very often an extra tillage operation has also been done to achieve the purpose. It may be useful to verify whether the effective incorporation of herbicide could also be done by using the existing implements like *desi* plough, blade harrow, etc. and whether it could be achieved as a part of the on-going field operations rather than doing an additional operation.

(d) A particular attention is required to find out suitable herbicide for perennial weeds. The exploratory trials in black soils of Andhra Pradesh have shown that Glyophospate [N-(phosphonomethyl) glycine] herbicide is very effective for the existing perennial weeds. The farmers have shown their willingness to buy this herbicide even if the cost is 'high'. There is a need to test its potential in other areas where such weeds are severe.

Management of Insects

In case of insect control there is unfortunately a heavy reliance on the use of chemicals despite the fact that the concept of IPM (integrated pest management) has been well recognized. This is primarily because field based information on other means of insect control, viz., cultural, biological, etc., are available only in limited situations. The integrated approach for insect management has a special significance for dryland agriculture, as it helps in reducing the total cost of cultivation and in improving the tability of yield at low level of management. In future, there is an urgent need to consider the following points for developing the integrated systems.

Avoidance of insects through cultural practices: The practices like time of sowing/planting, method of fertilizer placement, duration of genotype, row spacing, etc., have been found to have a direct bearing on pest problem. Through a proper choice of the above practices, the sensitive stage of the crop can be avoided from peak build-up of the pest[4].

The following examples would illustra[illegible] point.

(a) In case of sorghum in Hyderabad region (Table 1), early sowing or use of short-duration genotype (under delayed sowings) can evade the problem of earhead bug (*Calocaris* ungustatus).

TABLE 1 : Effect of sowing date and duration of genotypes on avoidance of earhead bug in sorghum in red soils of Hyderabad (1978)

Sowing time	Earhead bug/plant	
	CSH-6	CSH-5
May—25	5.6*	8.0*
June—15	6.9*	36.1**

*Flowered during August 16-26.
**Flowered during the second week of September.

(b) Similarly the placement of fertilizer (Table 2) helps in avoiding the problem of shootfly (*Atherigona soccata*) in sorghum through the rapid development of seeding vigour[5].

TABLE 2 : Effect of different methods of fertilizer application on shootfly incidence in sorghum at Hyderabad

Fertilizer placement	Shootfly incidence
Broadcast	25.4
Band placement	8.3

*A dose of 10 kg nitrogen and 30 kg P_2O_5 per ha was applied in both cases.

There is a need to understand the precise role of such practices for other major pests like aphids in mustard, pod borer in redgram, stem borer in sorghum, etc.

Capitalizing on natural parasitoids : A number of studies have brought out that natural parasitoids play an important role in minimizing the pest damage[6-7]. Preliminary experience at Hyderabad has revealed that an egg parasitoid (*Trichogramma sp.*) and a larval parasitoid (*microplitis sp.*) play important roles in controlling the semi-looper pest in castor. Experience at the biological laboratories in Mahaboobnagar has brought out that these natural parasitoids are less active during the month of June. Later the egg parasitoid becomes active during July whereas larval parasitoid becomes active during August. Therefore, it has interestingly been observed that a delayed-sown castor (i.e. during mid-July) completely avoids the semi-looper problem[4]. In case of early-sown crop (Table 3), the natural parasitoids are not able to control the pest due to their slow activity.

TABLE 3 : Effect of sowing date on the build up of semi-looper pest on early and delayed-sown castor at Hyderabad 1982

Period of observation	Av. No. of larvae / 10 sq m	
	Early sown	Delayed sown
July 1-15	Nil	Nil
July 16-31	16	0.7
August 1-15	61*	0.2

Early sown : June 1-15 ; delayed sown : July 1-15.
* Crop would have failed without pesticide use.

Understanding of pest-weather relationships : This is perhaps the most important aspect of integrated pest management in dryland agriculture. Many of the pests seems to have a definite relationship with weather conditions, e.g. pod borer in redgram as well as aphids in mustard are found to be highly connected with cloudy conditions at flowering time.

Certain pests are directly related with atmospheric drought. In Andhra Pradesh, the pests like leaf webber in groundnut, becomes severe during years when there is a long break in rainfall. Similarly Jassids and Thrips in chillies are also found to be associated with long gaps in rainfall during *kharif*. In such crops, the low yield during dry years is mainly because of the indirect effect of drought rather than due to the soil moisture stress. The pest-affected crop does not properly recover even when the rainfall revives subsequently.

A thorough understanding of pest weather relationship would thus help in taking timely control measures, avoiding the indiscriminate use of pesticides and eliminating residue, pollution and insect resistance problems against pests. It would be appropriate to mention that a lot can be learnt on this aspect out of the traditional wisdom existing with the farmers in different areas.

It is being now recognised that higher priority must be given in the dryland project to develop Integrated Pest Management for the major pests. It has been well recognised that rapid progress can be achieved through a systematic surveillance programmes which may help in understanding the behaviour of the pests in relation to agronomic practices, weather condition, etc. and also in determining economic thresholds of pests in the farmers' fields. Field staff with general agronomic background may be enough for the above purpose, provided guidance can be given through qualified entomologists available in Universities/research Institutes.

TABLE 4 : Major diseases in the various dryland crops

Crop	Scientific name	Disease	Region
Castor	*Ricinis communis*	Root-wilt	Telangana
Rabi sorghum	*Sorghum bicolor*	Charcoal rot	Deccan *rabi* areas
Redgram	*Cajanus cajan*	Root-wilt & Stem rot	Telangana
Bengalgram	*Cicer arietinum*	Root-wilt	Varanasi, Foot-hills of Shiwaliks etc.
Mustard	*Brassica compestris*	Mildews	Foot-hills of Shiwaliks
Coriander	*Coriandrum sativa*	Mildews	Deccan *rabi* areas
Safflower	*Carthamus tinctorius*	*Alternaria* & *Rhizoctonia*	Deccan *rabi* areas
Pearl millet	*Pennisetum typhoide*	Ergot	Major areas of pearl millet
Groundnut	*Arachis hypogea*	Bud-necrosis	Andhra Pradesh
Greengram	*Phaseolus aureus*	Buden-crosis Yellow mosaic	Andhra Pradesh Haryana

Disease Control

Many of the diseases have so far been controlled through the genetic approach. The control of downy mildew in pearl millet and grain weathering in *kharif* sorghum are the well known examples. However, a number of diseases still continue to be the potential threat to the transfer of improved technology. Some of the examples are illustrated in Table 4.

There is a need to concentrate the efforts towards a systematic screening of new genotypes in the sick-plots. Many a time, the sick-plots are easily found in the farmers' fields which can be utilized at least for a qualitative characterization of the genetic material.

In situations, where resistant genotypes are not available, efforts should be made to identify cultural methods to avoid the problem. The following examples would illustrate the point :

(a) The root-wilt in castor is found to be a soil problem. It is found to be severe only in these fields where high quantity of organic matter is applied or where waterlogging occurs, Till we achieve. genetic resistance, the available genotypes may be avoided in the above situations. In Hyderadad region, the problem of bud-necrosis in groundnut has been found to be highly related to the date of sowing[5]. This seems to be due to the fluctuations in the population of natural vector.

TABLE 5 : Effecf of different dates of sowing on the intensity of bud-necrosis in groundnut at Hyderabad

Date of sowing	Bud-necorsis (%)
Mid June	22
Mid July	58
Mid August	42
Mid September	40
Mid October	14
Mid November	44
Mid December	54
Mid January	17

Source : ICRISAT Annual report—1977

The bud-necrosis in greengram in Medak district is found to be negligible in situations where early sowing is done and where fertilizer is properly applied (Table 5).

(b) Similarly, the problem of *Rhizoctonia* in safflower can be avoided through delay in sowing whereas the problem of ergot can be avoided through early sowing.

The above experiences clearly bring out that an integrated approach is not only cheaper but become inevitable in selected situations. □

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BIOENERGETICS OF SUGARCANE IN KONKAN

B. P. PATIL*

THE energy crisis and ever increasing prices of energy materials, as the demand is on increase, created global concern for the exploitation of solar energy for human welfare. This is, by far, the under-utilised potential sources of renewable energy. Unlike the many physical means developed to utilize the solar energy on large scale, the use of biological phenomenon (photosynthesis) by growing plants of high biochemical efficiency is the earliest known means of utilising sun's energy on large scale. The harvested produce of crops is the sun's trapped energy stored in bio-chemical compounds. On global basis the total dry matter produced by photosynthesis each year is a staggering 116 billion tonnes which is equivalent to six times the world's annual consumption of oil. But only a small fraction i.e. 0.8% of dry matter is produced on crop land (FAO, 1981).

Sun—the origin of all forms of energy

The incident solar energy on the earth surface is estimated to 460-470 cal/cm^2/day of which 45% is utilizable. But, only 2.5% is utilized by the vegetative cover of the earth. A critical analysis of global biochemical and physical phenomena provides an understanding that all energies have their direct or indirect origin in sun's past or present activities or radiation. This has been the potential source of energy for the world since ages and will remain inexhausted for endless future too.

Sugarcane—efficient solar harvester

Utilization of the solar energy by converting it physically or electrically needs sophisticated equipments and involves high cost. But, the biological machinery by exploiting the plants of high photosynthetic efficiency can be an efficient and easy means of trapping sun's energy for utilization by human. Plants (green) are the only living organisms endowed with the properties to entrap solar energy in chemical compounds. In this context sugarcane (a C-4 plant) provides the best and most efficient crop for harnessing solar energy in easily available form. This crop by virtue of its growth habit develops an extensive green foliage, which is about seven times the land surface provided for the crop thus intercepting most of the solar radiation almost throughout its growth period. Naturally, it accumulates large biomass most of which is in the form of sugars.

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Production of liquid fuel-mineral oil substitue

Now-a-days liquid fuels (ethanol) of plant origin are produced from different biologically efficient crop plants like maize, sugarbeet, fodder beets, sweet sorghum and sugarcane by fermentation of carbohydrates. The efforts have now been intensified further to develop more efficient bio-fuels for substituting mineral oils, the hydro-carbons, presently in wide use. Corn, sweet sorghum fodder beet and sugarbeet containing 55.4%, 10.3%, 9.5%, 14.1% carbohydrates are reported to yield 1523, 1583, 2158 and 2060 gallons/ha of potential alcohol, respectively[1]. Potential alcohol production is estimated to be 1 gallon/14 lbs of fermentable carbohydrates Sugarcane is also among potential alcohol[8] (3300 to 4800 lit/ha) producing crops by virtue of its high total sugar content (16 to 18%) and high yield (over 150 t/ha). Presently sucrose being the main production for human consumption in India, the mollases are used for production of alcohol and other byproducts. But in future sugarcane will be one of the foremost crops for producing bio-fuels in order to lessen the dependence on mineral oils.

Yield and biological energy production by sugarcane in Konkan

The Konkan region of Maharashtra is a humid tropic with heavy rainfall during monsoon and clear bright sunshine from October to to May. Sugarcane, which prefers tropical humid climate, grows well in Konkan under irrigation like most humid regions of the world where it is giving high yields. In order to study the performance of different improved varieties in laterite soils of Konkan in terms of yield and bio-energy production a varietal trial was conducted at the Agricultural College Farm Dapoli in 1975-76. The crop was planted in second week of January at 90 cm in furrows with 3 budded 30,000 set/ha pretreated in agallol solution of 50 gm in 100 litres of water. Recommended dose of fertilizers (140 kg N + 125 kg P_2O_5 + 125 kg K_2O) was applied. Nitrogen was applied in four splits as 10, 40, 10 and 40%, respectively at planting with whole P and

TABLE 1 : Millable cane yield and bio-energy production by sugarcane varieties

Varieties	Millable[t] cane yield (t/ha)	C.C.S.[d] (t/ha)	Energy CCS (10⁶kg Cal)[e]	Estimated cane tops[f] (t/ha)	Energy tops[g] (10⁶ kg Cal)	Estimated bagasse[h] (t/ha)	Energy bagasse[i] (10⁶ kg Cal)	Total energy (10⁶ kg Cal/ha)	Energy harvest index* (EHI)	Energy ratio (ER)** (Fluck, 1979)[8]
Co. 1163	127.2 ab	14.5	57.2(32.4)	12.7	31.8(18.0)	41.9	87 5(49.6)	176.5(100.0)	0.3	19
Co. 740	120.4 ab	17.5	68.9(37.9)	12.1	30.0(16.5)	39.7	82.9(45.6)	181.6(100.0)	0.4	23
Co. 419	120.9 ab	16.1	63.2(35.8)	12.1	30.2(17.1)	39.9	83.3(47.1)	176.7(100.0)	0.4	21
Co.62175	175.3 c	21.8	85.8(34.3)	17.5	43.8(17.5)	57.8	120.7(48.2)	250.3(100.0)	0.3	28
Co. 975	161.7 bc	23.8	93.7(38.2)	16.2	40.4(16.5)	53.4	111.3(45.4)	245.4(100.0)	0.4	31
Co. 1287	164.2 c	18.3	71.9(31.8)	16.4	41.0(18.2)	54.2	113.1(50.0)	225.9(100.0)	0.3	24
Co. 1340	148.8 abc	18.7	73.4(34.5)	14.9	37.2(17.4)	49.1	102.4(48.1)	212.9(100.0)	0.4	24
Co. 6304	149.4 abc	19.6	77.0(35.5)	14.9	37.3(17.2)	49.3	102.8(47.4)	217.1(100.0)	0.4	26
MS.68/31	111.7 a	14.7	57.9(35.6)	11.2	27.9(17.2)	36.9	76.9(47.3)	162.7(100.0)	0.4	19
MS.68/47	161.1 bc	22.3	87.8(36.8)	16.1	40.2(16.8)	53.2	110.9(46.4)	238.9(100.0)	0.4	29

Figures in parentheses are percentage of total energy

[t] Figures following same letter are N.S.

[d] Commercial cane sugar

[e] 1 t sugar equivalent to 16492.9 MJ 1MJ = 238.7 kg Cal

[f] 1% of sugarcane yield

[g] 1 t tops = 10465 MJ

[h] 33% of sugarcane yield

[i] 1 t bagasse = 8740 MJ

**ER = $\frac{\text{Output of sugar energy}}{\text{Input of energy in NPK}}$

1 kg N = 77.5 MJ
1 kg P = 14.02 MJ
1 kg K = 9.69 MJ

*EHI = $\frac{\text{Energy sugars}}{\text{Energy sugar} + \text{Energy bagasse} + \text{Energy tops}}$

K, 6 to 8 weeks after planting, 12 to 14 weeks after planting and 16 to 18 weeks after planting or at earthing up. About 15 irrigations were given to the crop. The crop was harvested in the second week of January after testing the brix between 18 to 21% by refractometer. The data on millable cane yield, commercial cane sugar yield (CCS), estimated bagasse and green top yields and contribution of these to total energy production has been presented in Table 1.

The data in Table 1 reveals that the variety Co. 62175 and Co. 1287 gave significantly higher yield than Co. 1163, Co. 740, Co. 419, MS 68/31 but their yield did not differ significantly than Co. 975, MS 68/47, Co. 1340 and Co. 6304.

In case of CCS t/ha the similar trend was observed in high yielding varieties. But the varieties Co. 740, MS 68/31 inspite of their low yields of millable canes yielded appreciable amounts of CCS in comparison to Co. 1163 and Co. 419.

The data on energy production through commercial cane sugar estimated cane top yields and estimated bagasse yield indicated that about 35% of energy comes from commercial cane sugar whereas about 17% comes from green tops and about 48% from bagasse.

The total energy production in kg Cal/ha is strongly influenced by CCS on one hand and by the millable cane yield on the other. The cane yield of Co. 740 and Co. 419 had a difference of hardly one tonne/ha but Co. 740 gave about 5×10^6 kg Cal/ha/yr higher yield of energy than later. Similarly, the variety Co. 1163 gave about 7 t/ha/yr higher yield of millable canes than Co. 740, while it gave about 5×10^6 kg Cal/ha/yr less energy production due to low content of CCS. Same observation can be made with Co. 1287 as against Co. 975.

On an average, a twelve month crop of sugarcane from January to December produced about 200×10^6 kg Cal/ha/yr in Konkan region of Maharashtra which comes to about 0.55×10^6 kg Cal/ha/day. It is about 1.17% of the incident solar energy on the surface of the earth.

Thus, increasing demand for commercial energy calls for giving utmost consideration for efficient energy production through photosynthesis. Use of this energy as mineral oil substitute will induce farmers to shift their land use at least partly for efficient energy producing crops like sugarcane in near future.

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SELF-DELIVERANCE OR DIGNIFIED SUICIDE

SHASHIBHUSHAN RATH*

Analyses the psychosomatic roots of the instinct called suicide and emphasises that in case of dying patients suicide is not a crime but a relief from the angst, pain and psychological stresses of an individual who not only is a patient but a member of his own family, a parent and a member of the society. Suicide in such cases is never a form of self-condemnation as it usually is but a dignified one, a self-deliverance where the patient voluntarily exits himself from the sick-self nevertheless with significant socio-economical impact.

A hundred years back in a magazine like the Nature a news item revealed that scorpions had a suicidal tendency. We know how the scorpion, if surrounded by a circle of fire, runs the sting into its own head and so expires. Mr. Allen Thomson after conducting an observation at Lucca reported that the scorpion when kept in a glass jar with a bright lamp focussed on it, it loses its head with excitement and then brings the curved sting down upon itself and pierces forcibly. In a moment its sorrows are over and its excitement amounting to despair ceases to vex it. It is in fact, odd to note that such a suicidal mania should be hereditary in scorpions because the dead ones cannot have reported to the survivors that the experiment is successful, while suicide is far from complying with the Darwinian conditions, and favouring the persistence of the species.

Recently too, it was reported (courtesy UPI) that in Tokyo about 150 dolphins hurled themselves ashore in Southern Japan and many died despite efforts to push them back to sea. An official at the Children's World Marine Park said the 2-3 meter long mammals were lying exhausted and were dying on the beach at Aoshima, in Miyazaki province, 965 km south of Tokyo. Fishermen and residents laboured to shove the dolphins out to sea but they returned as if determined to die.

Suicide and Self

Most of the individuals undergo a suicidogenic period sometime or other in their lives, which in fact, is a characteristic of young adult life. The reasons for these gestures of hollow despair are not adequate enough to explain the cause of suicide. It is also observed that the state of mind is a mixed one—the consequential action and the inherent negation. For example, the American teenager driving down the highway at 90 miles per hour is not necessarily going anywhere; here driving down is the consequential action and apparently going nowhere is inherent negation.

Alienation is deep-rooted in our existence. It might sound simple but quoting R.D. Laing, "We are bemused and crazed creatures, strangers to our true selves, to one another, and to the spiritual and material world—mad even from an ideal stand point we can glimpse but not adopt". It is the realisation that we are potential but are in an alienated state we become outrageously violent, sometimes inwardly and sometimes outwardly.

We cannot understand thoroughly the mental condition at which a person attempts suicide. However, one of the explanations given by neo-psychoanalysts is: "I see you, and you see me. I experience you and you experience me. I see your behaviour. But I do not and never have and never will see your experience of me. Just as you cannot 'see' my experience of you. My experience of you is not 'inside' me. It is simply you as I experience you. And I do not experience you as 'inside' me."

Suicidal tendency is not a state of insanity because sanity today appears to rest very largely on a capacity to adapt to the external world, the interpersonal world and the realm of human collectiveness. Due to the estrangement of the outer world from the inner, any direct awareness of the inner world leads to grave risks.

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We have had accounts of man as animals, man as machines, man as biochemical complexes with certain ways of their own, but there remains the greatest difficulty in achieving a human understanding of man in human terms. That is precisely the reason for not finding any intelligibility in the suicidal behaviour of patients suffering from terminating diseases. In other words, we cannot find any intelligibility in behaviour if we see it as an inessential phase in an essentially inhuman process. Scope should be given to man to realise that though divided into several he is capable of being one.

Doubt and Social System

The rate and distribution of suicide is a property of the system : that there is something about the society, the region or the group that generates its characteristic suicide rate. That is, individual's doubt about the value system of his fellow men, himself, the existing social and cultural systems makes him exasperating for nothing and in turn affects the rate of suicide. Quoting Durkheim : "what is the end of suffering above all. The problem does not exist for the believer firm in his faith or the man strongly bound by the ties of domestic or political society. But more the believer doubts more does he become a mystery to himself, unable to escape the exasperating and agonising question : to what purpose ? No proof is needed that in such a state of confusion the least cause of discouragement may easily give birth to desperate resolutions. If life is not worth the trouble of being lived, everything becomes a pretext to rid ourselves of it".

In spite of the limitations of his sociological theory, suicide, for Durkheim was the mark of civilisation in crisis, of a society which rejects certain of its members who have not managed to integrate themselves into their socio-cultural surroundings. In his treatise on suicide, Durkheim observed that suicide increased not only in times of depression but also in times of rapidly increasing prosperity. He called it 'Suicide anomique'. The disjunction between goals and means, and the consequent strain, leads to a weakening of men's commitment to the goals, that is, to a state of anomie. Robert K. Merton spells out the logically possible ways in which they can adapt to this disjunction : they may either accept or reject the goals ; they may either accept or reject the means.

Suicide is a reaction of the outcast. It is a sort of safety valve or emergency exit that prevents the excessive accumulation of discontentment, frustration and unsatisfied wants. Quite often failure in performing one's role in the social set-up also leads to suicide. Telling things like : "I am such and such a sort of person. I invite you to deal with me on this basis so that you may expect certain things from me" become the root cause of disintegration of personality unless validated by meeting the cultural criteria of the role. Confirmation of our conception about ourselves acts as a check against the emergency exit, which we call suicide. In a sense, we ourselves are responsible for the individual's suicidal tendency. Laing in the Birds of Paradise has very rightly said : "We are all murderers and prostitutes—no matter to what culture, class, nation or society one belongs to, no matter how normal, moral or mature one takes oneself to be".

Whys and Hows of Self-deliverance

The desire to commit self-deliverance can originate from an endless array of circumstances like mental illness, inability to adjust with day-to-day transactions, and can also be a simple desire of an old man to die with dignity as a positive measure by putting an end to the state of unhappy dependancy on the members of a disinterested society that glorifies youth. Jains, even today, observe a suicidal technique known as 'Santharo'—in which death is slow and is caused through starvation.

Euthanasia or as is commonly known, mercy-killing, is derived from Greek meaning a good or happy death referring to the inducement of death by putting the incurable or terminally ill patient to eternal sleep, obviously at their own request. However, there arises a related question : whether a person can be granted a legal sanction to end his life by the other, not because of his debility but because he likes to truncate his life after a full and active living prior to his becoming a burden to his family or society. Such a sanction as a remedy for unbearable pain has been given by Aristotle in his book Politics and also by Plato in the Republic.

Euthanasia is usually understood as mercy-killing by 'the other' basing on the request of the terminally ill patient. It is a paradox in itself from the madical point of view because it contradicts the Hippocratic Oath. The oath is the embodiment of the duties, obligations and ethics of the physicians which assures to relieve suffering, protect and pro-t long life. When the patient is in the mos unbearable, painful stages of a fatal disease like cancer, to prolong life violets the assurance to relieve pain, and again, to relieve pain by killing violets the promise to prolong and protect life. Under such ethical paradox, although no religion or law sanctions suicide, euthanasia by 'oneself' or self-deliverance should not be a crime nor should it be unethical.

Dr. Charlotte Gilmann, herself an American physician, while dying of cancer penned the lines : "when all usefulness is assured of an imminent and unavoidable death, it is the simplest of the human rights to choose a quick and easy death in place of a slow and horrible one. The time is approaching when we shall consider it abhorrent to allow a human being to lie in prolonged agony. For this reason and conviction I have preferred chloroform to cancer".

In this context I remember Kant, for whom the 'other self' is not another Kind of object—for the whole concept of 'objectness' is foreign to the meaning of the 'self'. The 'other self' therefore, is not something to be 'known' but a 'person' towards whom we must act responsibly. A few cases are outlined below :

James Haig's age is 24. He is determined not to live out his natural life because he is paralysed from neck downwards. He says, "I believe there is an afterlife but I do not know if it will be any better than this one". He has attempted at suicide twice but has failed. Because of his almost total disability the first attempt was well organised with an assistant but at the last moment the assistant backed out for the fear of penalty (sentence for fourteen years) imposed on persons aiding suicide. In the second attempt he tried to drive his electrically operated wheel-chair into the river Thames but a few feet ahead the chair toppled over. However, he has confessed before the Observer that his wish to die still remains strong. Above all these, he has told his wife to start a separate life so that she is not marked by the stigma of suicide.

Second case is that of a leading tumour specialist who treats two hundred tumour patients a year, states that he would take his own life if he himself was dying of a particularly painful cancer, because he doesn't trust his colleagues to be able to supress the pain. It indicates that in such type of special context there is nothing wrong at all taking one's own life.

Thus suicide can be a powerful method of self-deliverance especially for patients who are terminally ill. In the recent past Exit, a not so well-known British group had its membership shooting as high as 9,000. The reason being the publication of a ten thousand word booklet titled 'A Guide to Self-deliverance'. But soon after its publication it was banned in the UK. Recently however, a number of sister societies have come up in the States viz. Hemlock Society : Concern for Dying, Society for Right to Die etc. Hemlock Society plans to go ahead with the publication of the pamphlet inspite of the fear of prosecution because its director Derek Humphry is of the opinion that thousands of people want this information and such a publication will create a climate of opinion that will tolerate the right of the terminally ill to end their own lives.

There is nothing wrong in exiting oneself.

Humphry first published the title "Jean's Way" in 1978 giving an account of how he helped his wife, a bone cancer victim to die on her own terms and not those of the disease that ravaged her body. Nearly a thousand letters and telephone calls from the dying and their relatives followed, all of them wanting to know from Humphry how they could end lives in extremis or where such data could be obtained. Assuring himself that a particular patient was terminal and not suffering from emotional problems he sent out photocopies of the list of lethal doses of commonly used drugs.

Administration of lethal drugs like hexobarbitone or thiopentone by injection has a sedative effect and has also been described as pleasant, romantic and lovely. While commenting on the mode of Execution the Royal Commission says : "in about 20 or 30 seconds, perhaps before the dose was completed the drug would reach the brain. There would be no danger of failure if a large enough dose were given, and the prisoner would feel nothing after the prick of the needle".

It should be the fundamental right of everyman to die a dignified death. Minoo Masani has set up an Indian branch of the Society for the Right to Die with Dignity (SFRDD). There are already 27 branches all over the world with many eminent writers, doctors, scientists, lawyers and industrialists as its members.

In Steppenwolf, Herman Hesse has put in a succint way : "Finally, when he was about 47 years old, Harry had a happy, not entirely humourless thought. He set the date of his fiftieth birthday as the day on which he would allow himself to commit suicide. On that day, he agreed with himself that he would be free to use or not to use that emergency exit......". Let us die the Cleopatra's death which is nothing but dignified suicide. Death, one day, will no more remain a gnome, a dread but instead will be a sort of relief, an exit, a deliverance. ☐

NOTES & NEWS

The National Symposium on Pigment Metabolism in relation to Vitiligo

Under the auspices of Indian Chemical Society and other cosponsors like IADVL (W.B. Branch and Central Organisations), Bose Institute, AIIMS, ICMR, DST, New Delhi, a National Symposium on Pigment Metabolism in relation to Vitiligo was held at Bose Institute, Calcutta on September 22-23, 1984.

The symposium was inaugurated by Prof. B. K. Bachhawat, Director, IICB, Calcutta and presided over by Dr. B. N. Banerjee, an eminent Dermatologist of India. The Convener of the symposium Prof. D. P. Chakraborty, Chairman, Department of Chemistry, Bose Institute called upon the Doctors and Scientists to take up a cordinated programme of this subject of interdisciplinary scientific investigation to fight the national malady which in consideration of its incidence was next to tuberculosis and leprosy in India. Speakers from different parts of India and Prof. A. B. Lerner of the school of Medicine, Yale University, U.S.A., spoke in the meeting. Prof. Lerner put forward that abnormal melanoma cells were responsible for this malady. Neurogenic factors may be contributory to this malady. Dr. B. N. Behl, Director Skin Institute, New Delhi, suggested that different etilogical factors are presumably at play in different individuals. Hence, the treatment has to be individualised. Prof. S. K. Panja in his talk suggested that histamine is a toxic mediator for the pathogenesis of Vitiligo. Prof. R. K. Panja presented his data on the role of hypothalamus in Vitiligo. Dr. A. K. Dutta presented a review on the basis of his data on clinical observation that the cases should be classified into different groups. Prof. D. P.

Chakraborty in his lecture spoke on the introduction of pure psoralen as a chemotheraputic agent in 1957 by himself and Dr. A. K. Roychowdhury and its efficacy as the best of the group of drugs used in Vitiligo. The lecture of Prof. J. N. Chatterjee on the synthesis of compounds related to psoralen was presented by Dr. D. Mal. Prof A. Ramaiah of AIIMS spoke on the modification of the solubilized enzyme tyrosinase from melanosormal fraction on exposure to pH 5.0 on citrate. Prof. D. P. Mukherjee spoke on the anthropological genetical aspects of the disease. The frequency of the disease in different strata of the society their geographical location in India were also mentioned. The physiological aspects of Vitiligo patients were discussed by several workers.

A resolution requesting the publishers of various dictionaries to state correct meaning of Vitiligo, as a disease of the pigmentory disorder instead of a variety of leprosy was passed by the general meeting of the Symposium. □

D. P. Chakraborty

Highlights of Research and Development under Department of Atomic Energy during 1983-84

India's programme for the utilisation of atomic energy for its economical development made rapid strides during 1983-84. The power reactor (unit-I) at Kalpakkam designed, engineered and built entirely by Indian Scientists and engineers, attained criticality on July 2, 1983 and was synchronised to the grid by the Prime Minister on July 23, 1983. India is thus one of the few countries in the World capable of designing, building, fuelling and operating power reactors entirely on its own. The power reactor (unit II) at Rawatbhata achieved record performance with an operating factor of 85.33 per cent during the year. In the latter half of the year the heavy water plants at Baroda and Tuticorin have been producing their targetted quantities.

R & D at BARC : Research and development activities at the Bhabha Atomic Research Centre (BARC) moved forward contributing to the building up of the nuclear power programme of the country with significant spin-offs in the fields of space, defence, industry, agriculture and medicine. Founded in 1957 at the Atomic Energy Establishment at Trombay, BARC's activities cover diverse fields such as physics, chemistry, engineering, metallurgy, reprocessing, fuel fabrication, waste management, radio-isotopes, electronics instrumentation, lasers, biology, agriculture, food technology, radiation medicine etc.

Research Reactors : In the field of research reactors expertise from design to operation stage has been fully developed. The country's MW swimming pool reactor APSARA built in 1956, countinues to be used for isotope production and physics experiments.

The 40 MW CIRUS reactor, operating since 1960 has provided valuable production, experimentation and training facilities. Commissioned in 1961, ZERLINA—the zero energy reactor, was decommissioned in 1983 after rendering useful service in studying new reactor concepts and components.

The zero energy fast reactor assembly PURNIMA was built in1972 and is presently under modification to operate using uranium (233) fuel (PURNIMA II). Another mini-pool reactor also containing uranium (233) as fuel, is under construction at Kalpakkam, for neutron radiography experiments.

A new high flux indigenous reactor at Trombay, called DHRUVA will be commissioned in 1984. DHRUVA is a natural uranium heavy water moderated reactor of 100 MW thermal power and incorporates several new features including a new fuel concept.

Nuclear Fuel Research & Development: Since the inception of atomic energy programme, R & D efforts have been directed towards achieving selfreliance in meeting the fuel needs of the reactors. The Uranium Metal Plant at Trombay, which produced its first ingot of fuel in January 1959 was partially recommissioned during the year.

Fuel elements and subassemblies for CIRUS reactor and metallic uranium fuel clusters and other components for DHRUVA reactor were fabricated. Design and fabrication work for the new plutonium rich carbide fuel was undertaken at BARC. Development work on uranium (233) based fuel fabrication as well as R & D work in thorium utilisation was carried out.

Reactor Research Centre: The Reactor Research Centre was established in 1971 at Kalpakkam, Tamil Nadu, to carry out development of sophisticated breeder technology. The Fast Breeder Test Reactor is expected to be commissioned towards the end of 1984. This is a 40 MW thermal sodium cooled reactor. It will generate about 15 MW of electrical power, using mixed carbide fuel developed and manufactured at Trombay. Laboratories have been commissioned for handling active materials, reprocessing and separation of plutonium, sodium, materials development, reactor engineering, electronics and instrumentation, and safety research.

Work on the design of 500 MWe Prototype Fast Breeder Reactor commenced and preliminary reports prepared.

Centre for Advanced Technology: Work on setting up the Centre for Advanced Technology at Indore commenced on February 19, 1984 with the unveiling of a plaque by the President.

The Centre will work on a variety of advanced and frontier technologies which have been engaging the attention of BARC, such as accelerators, lasers and fusion. The Centre will evolve designs for large high enery acceleretors, laser systems for fusion investigations and advanced MHD systems etc.

Variable Energy Cyclotron Centre (VECC): VEC, set up at Calcutta by BARC, is emerging as a national research facility with the major users being scientists from universities througout the country. An additional beam transport channel and radiofrequency system were commissioned this year.

Magnetohydrodynamics (MHD) Project: BARC, in collaboration with BHEL, has been engaged on the development of an experimental 5 MW MHD plant at Tiruchirapalli, Tamil Nadu, the construction work of which was largely completed. The plant is expected to be in operation in 1984.

Support to Basic Research in Nuclear Sciences: In addition to the High Altitude Research Laboratory at Gulmarg, National Research Laboratory at Srinagar and Seismology Station at Gauribidanur, institutions aided by DAE like the Tata Institue of Fundamental Research and the Saha Institute to Nuclear Physics, Calcutta are engaged in research geared to achieve self-reliant base in nuclear science and technology. DAE also supported research and development work in various disciplines related to atomic energy in Indian universities and other academic institutions by giving project-linked financial assistance and fellowships. The Department also provided grants to institutions for the development of mathematics. During the year Rs. 1.3 crores were allocated by DAE as grants-in-aid to universities and institutions. ☐

Nuclear India

Active manganese dioxide

Manganese dioxide is a good conductor of electricity and is largely used in the manufacture of dry cells. Since production in the country is not adequate, active manganese dioxide has to be imported every year in considerable quantity.

Though pyrolusite is the common source of manganese compounds, the difficulty is that manganese salts when heated with oxidising agents such as nitric acid, potassium permanganate, nitrosyl chloride as well as ammonia plus bromine does not yield pure manganese dioxide. Although pure manganase dioxide can be produced by heating manganese nitrate to a temperature of about 200 degree centigrade, the method is not sufficient to meet commercially demands of active manganese dioxide. Again, though active manganese dioxide can be obtained by electrolytic method, its feasibility, however, lies where electricity is cheap. But this process does not seem to be appropriate at present since production of active manganese dioxide requires a large amount of power varying from 6000 to 7000 KWh for each tonne of the material.

Researchers of the Regional Research Laboratory, Bhubaneswar revealed that for the purpose of obtaining active manganese dioxide, a low-grade manganese ore even can be employed. The process consists in treating ground ore with ferrous sulphate when the corresponding sulphate is formed. Ammonium sulphate can also be used. These sulphates are then converted into the carbonates or the hydroxides. Both on heating produce manganese dioxide. This operation is called calcination and the sulphate production the sulphatisation. One of the advantages of using the process is that active manganese dioxide can be produced from any kind of ore available indigenously. □

P. C. Bhattacharyya

Research into mine safety

Greater safety and more efficiency in the coal industry is the aim of Australian Government-funded research into methane-gas drainage from mines.

Gas drainage is a technique by which gas is extracted from the coal seam and taken to the surface. This reduces the risk of outbursts of gas and coal at the workface—the possibility of explosions and fires. It markedly reduces the problems of ventilation and improves productivity.

The project has proved extremely effective in reducing the methane concentration in the mine working area and the risk of outbursts. As a result, more coal can be won. Recovery has been increased and operating costs have been reduced. Subject to market availability the mine, West Cliff Colliery in New South Wales, is now able to mine in a year up to one million tonnes more of the export-coking coal A pilot plant has been installed to use the vented methane to generate electicity. □

Australian Information Service

Garden-Waste shredder

Gardeners will be able to convert garden rubbish into soil-enriching mulch by using a cheap portable device invented by a South Australian lawnmower serviceman, Kenneth Schuppan. The attachment fits under conventional rotary mowers and uses the blades to shred organic matter into garden-ready mulch. An additional power unit is not required, which gives the device a significant cost advantage over other shredding systems. □

Australian Information Service

New-style desalination system

Australian engineers have developed a continuous magnetic ion-exchange system for desalting large amounts of brackish water by using specially treated resins in a process sought unsuccessfully in other parts of the world for about 30 years.

The demonstration plant, with a production capacity of one million L of potable water per day, is capable of desalting enough brackish water to supply a town of up to 10,000 people with sufficient cooking, drinking and washing water for a year.

The system—Sirotherm—is a joint project between Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), Perth's Metropolitan Water Authority (MWA) and private industry. The system uses magnetised ion-exchange resins, specially developed by the CSIRO and ICI, to lift the salt from brackish water and a hot-water process removes the salt.

A major advantage of the process over other desalination system is its capability for continuous regeneration. The plant never has to be shut down and this gives it a great merit in operating simplicity and improved operating economics. Another benefit is that it only uses cheap low-grade heat in its operation and if necessary it could use solar heat for some stages. □

Australian Information Service

BOOK REVIEWS

The Sulbasutras—S. N. Sen and A. K. Bag. Publisher : Indian National Science Academy, New Delhi, 1983. Pp. 293. Price Rs. 85/-.

Different sciences have flourished at different times in different societies. They have been directly related to the habits, modes of thinking and the social organisations of those communities. This itself is an interesting study—the logical connection between the habits and rituals and the technologies evolving out of those practices, between the culture and the specialised branch of knowledge which evolved out of that culture.

History of science has recently emerged as a separate academic discipline. This calls for the active co-operation of scientists as well as historians so that the intellectual activity which began since man first came to grips with nature can be studied from a variety of angles.

It is very gratifying to see that the Indian National Science Academy has taken upon itself the task of initiating researches on the sources of history—to provide the ready raw material so to speak for the serious scholars and historians. Until very recently the educated Indian was conditioned to believe that all light came from the west and science had its sacred origin in Greece. It is time the younger generation were given a more pervasive and neutral view of history.

The widely accepted belief that geometry had its crude origin as a set of practical rules for mensuration and land-surveying in ancient Egypt and Babylon is now being questioned. Scholars are now of opinion that the knowledge of geometry needed for the purpose of land measurement was only an approximate knowledge. The theory that exact geometry arose out of land surveying in Egypt or Babylon is not supported by evidence. On the other hand geometry in the sense of an exact science developed from the techniques of the masons, architects and engineers. This clearly points out to the evidence we have from Indian cultural history and in a different technological context, namely that of brick-making and brick-laying.

The Pythagorus theorem was also known to ancient Indians, who came upon it by way of constructing square and rectangular shaped alters. This geometry has come down to us as codified in a class of literature called the SULBA SUTRAS.

Thanks to the painstaking work done by S. N. Sen and A. K. Bag—This volume provide us with a glimpse, showing us how the development of geometry and algebra was inherent in our scriptural tradition. The Sulbasutras are manuals for the construction of altars for fire-sacrifice. Of the various composers of these formulas or sutras they have selected four—Bandhayana, Apastamba, Katyayana and Manava. The original sanskrit texts are given in Roman script along with their English translation. In the third section of the book we have the commentaries given by Sen and Bag.

In the commentary the units of measurement used by the sutrakars are discussed and explained not in the order in which they appear, but edited according to importance and avoiding overlapping. The mathematical significance of the text can be well understood from the way methods of constructing squares and transformation of geometric figures, heights, distances positions etc. are mentioned, even placement of bricks for each layer is to be done in accordance with special rules. Bandhayana proposes two types for making a fire—altar in the form of a falcon with curved wings and extended tail. Apastamba gives the formula for two variations of the same figure.

There is a lot of controversy regarding the exact time and place of the writing of these sutras, but there is general agreement that the sutras were composed between 800 to 500 B.C. The involved and irregular forms used by the first two put them very definitely before Panini. The evidences put forward by various scholars have been discussed in the introduction. There is an equally valuable index of technical terms used in the original text. Sen and Bag deserve our thanks, not only for the stupendous labour involved in the compilation, but also for their cool, rational analysis, particularly because the whole thing is submerged in religious rituals. The structures were supposed to have special significance—part magical part relegious, for example, in order to ensure entry into heaven, the altar had to be made in the shape of a falcon. For the destruction of one's enemy, the altar was to be built in the shape of a chariot-wheel. The shape of the altar was connected with specific desires, or wishes to be fulfilled. But along with this kind of faith flows reason—how exactly to construct the altars and a thorough knowledge of the technology involved. ☐

Enakshi Çhatterjee

Catastrophe theory and applications, Ed. D. K. Sinha. Publisher: South Asian Publishers Pvt. Ltd., Pp. xii + 158. Price Rs. 75/-.

There is, hardly, any branch of science to which the catastrophe theory has not been applied. Unfortunately only a few books are available which simultaneously bring out the basic contents of the catastrophe theory along with examples of their applications to various disciplines. The current publications, which arose out an interdisciplinary seminar conducted in 1979 at Jadavpur University, admirably fulfils the dual purpose of acquainting research workers with the recent trends and developments in catastrophe theory and providing examples of useful applications of the theory in physics, bio-physics, earth sciences, medical sciences and linguistics.

The first six papers of the present volume have been written by Prof. E. C. Zeeman alone or with his colleagues, who, as is well known, is perhaps the most important mathematician who has been responsible from enlarging the scope of Catastrophe theory as a mathematical method discovered by Rene Thom to describe evolution of forms of nature to its present extensions covering large areas of pure and applied mathematics. In the first paper Zeeman has discussed the seven elementary catastrophes, his famous catastrophe machine and application of Catastrophe theory to factors governing aggressive behaviour in animals. In the following articles, applications of catastrophe theory to the stability theory and light caustics have been discussed. In the next paper Zeeman along with Smith and Harrison have analysed some discontinuous processes associated with Baysian decision theory. Zeeman has discussed the applications of Catastrophe theory to the anorexia nervosa and its cure by trance theraphy. In the next paper Prof. Zeeman has given replies to some of the questions raised during the seminar on general theoretical aspects, as well as of their potential fields of applications. In the following paper Prof. C. K. Majumdar has discussed the application of Catastrophe theory to phase transitions and nuclear fission. In his paper, Prof. J. N. Kapur has examined the problem of competition of species from three points of view viz. Lotka-Volterra theory, the theory of games and Thom-Zeeman Catastrophe theory. In an interesting article Dr. A. K. Roy has described how a logics-mathematical theory of languages can be developed. This has been followed by a paper on the language aspects of Catastrophe theory. Biomechanical applications of Catastrophe theory have been discussed by Prof. D. K. Sinha while applications to earth sciences have been discussed by Mitra and Sinha. Bifurcations of time periodic solutions which are important in the investigations on regulatory biochemical networks has been examined by Dr. A. B. Roy using Catastrophe theory, while applications of bifurcation theory in physical and biochemical systems have been considered by Dr. D. Sen. An important feature of the book is an extensive bibliography on Catastrophe theory prepared by Dr. Poston and Stewart.

Apart from a few minor printing errors, the book is almost free from blemishes. The editor and the organisers of the seminar deserve full credit for their valuable contributions in this field. ☐

A. M. Ghose

SCIENCE CORNER

Articles published in this section are for students and general readers for understanding science in the perspective of its fundamentals. We invite science teachers and scientists for contributing articles to this section. Also we shall appreciate comments from our readers on the articles published in this section.—*Ed.*

ACCELERATORS AND THEIR RECENT APPLICATIONS

S. B. KARMOHAPATRO*

WITH the dawn of the present century, the discovery of radioactivity by Bacquerel and Curie made a revolutionary change in our ideas about matter. To produce artificially radioactive substances from the stable elements, fast projectiles of charged particales were needed. Dirac predicted an antielectron or positron even an antiproton. Since the proton was 1836 times as massive as the electron, the formation of Antiproton required at least 1836 times as much energy as the formation of a positron. We had to wait for the development of accelerators for accelerating subatomic particles to sufficiently high energies.

In 1928 John D cockroff and Earnest Walton developed a machine to accelerate protons 400 thousand electron volt. One electronvolt is equal to the energy developed by an electron accelerated across an electric field with a potential of one electronvolt. With protons accelerated in this machine, they were able to break up the lithium nucleus, and for this work they were awarded the nobel prize for physics in 1951. Next Van de Graff developed an electrostatic generator and could accelerate protons to 8 Mev.

Another method gave birth to the linear accelerator in 1931 in which particles are driven down a tube divided into sections. The driving force is an alternating electric field, it is managed in such a way that as the particles enter each successive section, they get another push. Since the particles speed up as they go along, each section must be suitably longer than the one before, so that the particles will take the same time to get through it and will be in phase with the proper timing of the pushes.

A better idea conceived by E. O. Lawrence was given shape in a cyclotron in which the particles travel round a circular path. A magnet could bend them in such a path. Each time they completed a half circle, they would be given a kick by the alternating field. As the particles speeded up, they would move in wider circles and take the same time for each round trip, since in wider circles their velocities increase. By 1939, laboratory in the University of California had a cyclotron to raise proton energy to 20 Mev. Lawrence, the inventor of the cyclotron was recognised with the nobel prize in physics in the same year.

The acceleration due to cyclotron itself had to stop at about 20 Mev, because at that energy, the particles were travelling so fast that the mass increase with velocity—an effect predicted by Einstein's theory of Relativity—became appreciable. This increase in mass due to high velocity causes the particles to start lagging and falling out of phase with the electrical kicks. The remedy was worked out by Veksler and McMilan by synchronising the alterations of electric field with the increase in mass of the particles. Such modification of cyclotron, called synchro-cyclotron could be built up to raise the energy to 800 Mev.

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Electrons being lighter particles have separate problems for acceleration. To be useful in smashing atoms, the light electrons had to be raised to much higher speed than protons. The cyclotrons could not work for electrons, because at the high velocities needed to make the electrons effective, their increase in mass was too great. In 1940, Kerst designed a transformer device which balanced the increasing mass with an electric field of increasing strength. The electrons were kept in the same circular path instead of spiralling outwards. The instrument was named betatron, after beta particles. They can generate electrons upto 340 Mev.

A slightly different design called Electron Synchrotron was built by Goward and Barnes in 1946. These raise electrons to 1000 Mev, but cannot go beyond, because electrons moving in a circle radiate energy at increasing rates as velocity is increased. Such radiation produced by an accelerating particle is called Bremstrahlung, a german word meaning breaking radiation.

Taking lessons from the betatron and electron synchrotron, physicists working with protons began about 1947 to build proton synchrotrons which like-wise kept particles in a single circular path This was helpful in saving on weight. When particles move in spiralling paths, a magnet must extend the entire space of the spiral to keep the magnetic force uniform throughout. With the path in one circle, the magnet need be only large enough to cover a narrow area. Because the more massive proton does not lose energy with motion in a circular path rapidly as does the electron, physicists could surpass the 1000 Mev limit with a proton synchrotron. 1000 Mev is 1 Giga-ev. greek ward for gi. Brook-haven National Laboratory, in 1952, completed a proton synchrotron called cosmotron that reached 2 to 3 Gev. Two years later University of California developed a bevatron producing particles 5 to 6 Gev. In 1957 Soviet Union reached 10 Gev with their phasotron.

But by now these machines seem to be pigmies in comparison with accelerators of newer-type called the strong focussing synchrotorn. The limitation on the Bevatron type is that particles in the stream fly off into the walls of the channel in which they travel. The new type counter-acts this tendency by means of alternating magnetisc fields of different shape which keep focussing the particles in a narrow stream. This incidentally further decreased the size of the magnet required for the energy value attained. Where particle energy was increased fifty fold, the weight of the magnet involved was less than doubled.

In the year 1959 the European Committee for Nuclear Research (CERN) a cooperative agency of 12 nations completed in Geneva a strong focussing synchrotron which reached 24 Gev. Brookhaven constructed one reaching 30 Gev and the soviet union completed a similar machine of 70 Gev energy. CERN has been operating a super synchrotron of 270 Gev energy. A few others are completed or are near completion. 2000 Gev Synchrotron under development in the Fermilab requires special mention.

The idea has been welcome of having two accelerators in tandem so that a beam of energetic particles collides head on with another beam moving in the opposite direction. This will quadrupole the energy involved over the collision of one such beam with a stationary object.

Electron-positron collider or proton-antiproton collider synchrotron is a single machine, in which the collision occurs in the same magnet because of the opposite charges of the particles. CERN super-proton synchrotron as an antiproton collider reaches 540 Gev energy. A 50 Gev positron-electron collider is under construction at CERN.

From cosmotron to super synchrotron, the range of the modern synchrotron comprise a marvel in instrumentation. Like the lamp of Aladin, Physicists use these machines for what they ask for.

With merely the Bevatron, man at last came within reach of creating the antiproton. In 1955 Chamberlain and Segre bombarded copper with 6.2 Gev protons for many hours and definitely detected at least 60 anti-protons. They received the nobel prize in 1959 for their discovery.

The discovery established the basis for the existence of antimatter, a new concept in physics, predicted by Dirac long before.

Synchrotrons have helped as meson factories to discover a large number of elementary particles. These particles have changed our conventional concepts about matter and force. Particle physics is now a new subject sometimes called high energy physics, since the exotic particles are achieved through the collision of high energy particles.

Recently attempts are made by physicists to unite the cosmology and particle physics.

It is believed that the origin of the universe is due to an explosion called bigbang. In the moment of such creation all the four forces gravitation, strong nuclear force, weak nuclear force of β-decay, Electromagnetic forces were united together. At a moment, the force of gravitation separated, next the strong force. At the instant of 10^{-12} sec after the bigbang, electromagnetic force and weak force were unitedly was an electro-weak force not separated from each other. Glashow, Abdus Salam and Wienberg theoretically showed the existence of the electroweak force and predicted the existence of $W^{\pm}$ and Z^{o} particles by the electroweak theory. In 1979 they were awarded nobel prize, when a notable experimenter was heard to remark on learning the news "does this mean they will have to give the prize back if we do not find the Z or W". The question was to remain a hypothetical one. Thanks to the synchrotron which proved the prediction true. In 1983 the super proton synchrotron as proton antiproton collider run at an energy 540 Gev, definitely proved the existence of $W^{\pm}$ centered around 81 Gev and Z^{o} at 93 Gev at the rest mass energy, predicted by the theory. For conducting the experiment Rubbia and Meer have been awarded Nobel prize in physics in 1984 ; Meer was responsible for devising the stochastic cooling method to concentrate the Antiproton beam sufficient for interaction with the protons from the opposite direction to produce detectable $W^{\pm}$ and Z^{o}. The detector systems UA1 and UA2 operated by the scientists of CERN unequivocally produced the said intermediate vector Bosons, the exchange particles of the weak force. The experiment is described to be the most difficult one and to be one of the greatest achievements in science in the present century.

The 2000 Gev machine at Fermilab when completed will provide the highest energy within the reach of the physicists and will unveil many exotic phenomena which are not even imagined with a human mind. □

LETTERS TO THE EDITOR

'Kumar Jal'—a catfish fishing method of Hooghly-Matlah estuary

Fishing methods of Hooghly-Matlah estuary have been described in detail by a number of workers in the past[1-7]. But for a very brief mention regarding fishing with the help of bush[4], no account is available in literature regarding a barrier type of net, locally known as 'Kumar Jal', the principal net for catfish fishing, employed in lower reaches of Hooghly-Matlah estuary (Sunderbans area). This method of fishing was observed in detail by the authors while the senior author was working on biology and fishery of the canine catfish-eel, *Plotosus canius* Hamilton.

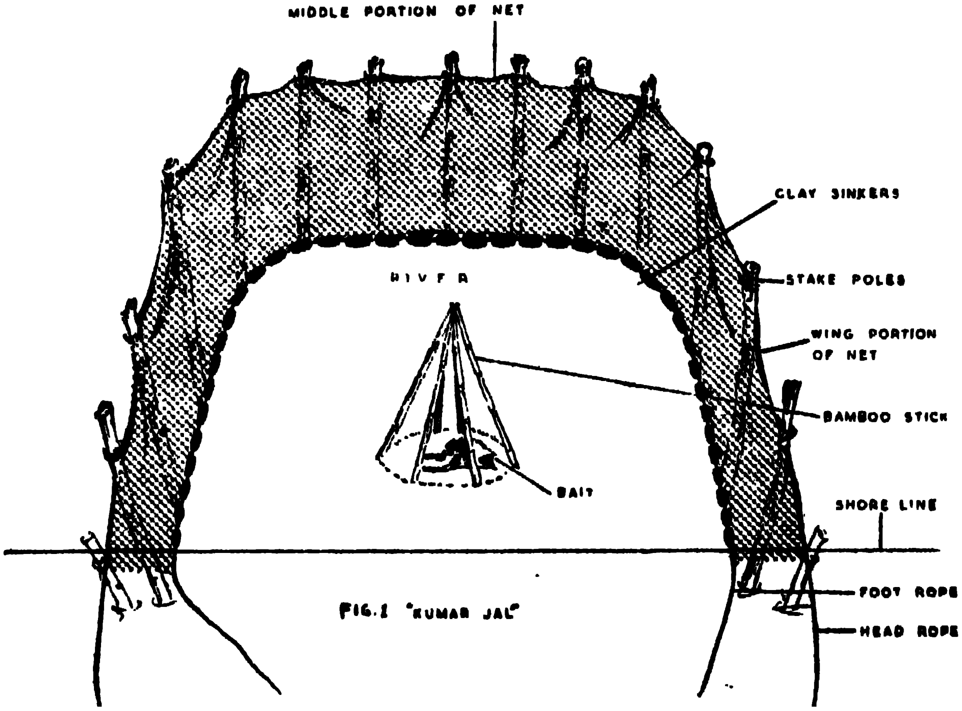

FIG. 1 'KUMAR JAL'

'Kumar Jal' consists of three pieces of nets, one middle piece and two wings, with foot and head ropes (Fig. 1). The mesh-size gradually increases from foot rope end to head rope end and ranges between 6-12 mm. The length of the middle piece varies between 30-36 m, whereas, each wing is 18-21 m in length. The height of the middle piece is 7.5-8 m and the wings about 3.5-6 m. The foot rope is weaved, like garland, with small fire clays which work as sinkers. The entire length of the net is variable, according to the area available for operation and manpower availability.

This net is operated near the bank having low water level. Twelve to fifteen days before actual operation, a bush, comprising of a bundle of split bamboo poles, is placed in a selected place in the river. The split bamboo pieces are tied at the top and their bottom free ends are fixed in the river bed (Fig. 1). Dead goat guts or small dead animals are tied within the framework of the bush to attract carnivorous fishes. When the fishes get accustomed to feed in the bush area in 12-15 day's time, a sizeable area around the bush is encircled with bamboo poles (stake poles) pitched in the river bed at an interval of 3-3.5 m, during the ebb tide period, without disturbing the bush. Now the foot rope of the net is buried in the river bed towards the bush side of these poles in such a way that no gap is left between the foot rope and the river bed. The wings are fixed towards embankment and the middle part towards the deeper water area. As the high tide reaches its peak, the net is fully stretched and the head rope is tied with the top of the stake poles. In this way a semicircle enclosure is made of the net, ensuring that the fishes which have come to feed in the bush area are unable to escape. When the ebb-tide starts, the foot rope is gradually dragged from the wing end towards the shore. The process of dragging is very slow and gentle. The bush is pulled off when the foot rope reaches near it. Ultimately, the foot rope of the middle piece touches the shore and the two wings overlap each other. As such, a bag is formed at the middle portion of the net and all fishes get slowly driven to this bag. At this stage, the head, rope is untied, simultaneously, by a number of fishermen, at all points, and brought to the shore, thus, covering the top of the bag. The captured fishes (mostly different species of *Mystus*, *P. canius* and other estuarine catfishes) are then removed.

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Anti-bacterial and anti-fungal activity of some new bis-(styryl) sulphones

The sulphones are probably best known in therapy and in agriculture[1,2]. The discovery of dapsone, 4, 4′-diaminodiphenyl sulphone, as potential drug against leprosy has revolutionised its whole treatment[3]. The sulphones are well known as fungicidal[4] and anti-leprotic agents[5]. Marked anti-tubercular[6] and antibacterial[6,7–9] activities are reported for sulphones. Vinyl sulphones possess the fungicidal[10] and anti-tumour activity[11]. The following new bis-(styryl) sulphones were synthesised and evaluated for their fungicidal and bactericidal activities according to the modified paper disc method of Thornberry[12]. The results are presented in Tables 1 and 2.

$$\mathrm{Ar-CH=CH-SO_2-CH=CH-Ar}$$

Compound Number	Ar
1	3 - ClC_6H_4
2	3, 4 - $Cl_2C_6H_3$
3	2 - FC_6H_4
4	4 - FC_6H_4
5	2 - $CH_3C_6H_4$
6	3, 4 - $(CH_3O)_2C_6H_3$
7	2, 3 - $(CH_3O)_2C_6H_3$
8	4 - $CH_3O\ C_6H_4$
9	2, 5 - $(CH_3O)_2C_6H_3$
10	2 - $NO_2C_6H_4$
11	3, 4 - (- O - CH_2 - O -)C_6H_3
12	3 - Pyridyl

TABLE 1 : Anti-fungal activity of twelve sulphones

Compound number	Zone of Inhibition** *Helminthospo-ruim oryzae* 1000 ppm	 *Helminthospo-ruim oryzae* 50 ppm	 *Corynespora cassiicola* 1000 ppm	 *Corynespora cassiicola* 50 ppm	 *Aspergillus niger* 1000 ppm	 *Aspergillus niger* 50 ppm	 *Alternaria solani* 1000 ppm	 *Alternaria solani* 50 ppm	 *Phizoctonia solani* 1000 ppm	 *Phizoctonia solani* 50 ppm	 *Pencillum notatum* 1000 ppm	 *Pencillum notatum* 50 ppm
1	+ +	–	+ +	–	+ +	–	+ +	–	+	–	+	–
2	+ +	–	+	–	+	–	+ +	–	–	–	+	–
3	+ + +	–	+ + +	–	+ + +	–	+ + +	–	+ + +	–	+ +	–
4	+ +	–	+ +	–	+ +	–	+ +	–	+ + +	–	+ +	–
5	+ + +	–	+ +	–	+ +	–	+ +	–	+	–	+ +	–
6	+	–	–	–	+ +	–	+	–	–	–	+	–
7	+ + +	–	+ + +	–	+ +	–	+ +	–	+ +	–	+ +	–
8	+ +	–	+	–	+ +	–	+ +	–	+ +	–	+	–
9	+	–	+ +	–	+ + +	–	+ +	–	+ +	–	+ + +	–
10	+	–	+	–	+ +	–	+	–	+	–	+ +	–
11	+	–	–	–	+	–	–	–	+	–	–	–
12	+ + +	+	+ + +	+	+ + +	+	+ + +	+	+ + +	+	+ + +	+
Thiram	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +

** + indicates zone diameter between 6-8 mm, + + indicates zone diameter between 9-14 mm, + + + indicates zone diameter between 15-20 mm, + + + + indicates zone diameter more then 20 mm and – indicates no inhibitory zone.

TABLE 2 : Anti-bacterial activity of twelve sulphones

Compound number	Zone of Inhibition** *Rhizobium japonicum* 1000 ppm	 *Rhizobium japonicum* 50 ppm	 *Bacillus subtilis* 1000 ppm	 *Bacillus subtilis* 50 ppm	 *Xanthomonas oryzae* 1000 ppm	 *Xanthomonas oryzae* 50 ppm	 *Pseudomonas viticola* 1000 ppm	 *Pseudomonas viticola* 50 ppm
1	+ +	–	+	–	+ +	–	+ +	–
2	+ + +	–	+ +	–	+ +	–	+ +	–
3	+ + +	–	+ +	–	+	–	+	–
4	+ +	–	+ + +	–	+ + +	–	+ + +	–
5	+ +	–	+ +	–	+	–	+	–
6	+ +	–	+ +	–	–	–	–	–
7	+ +	–	+ +	–	+ +	–	+	–
8	–	–	–	–	+	–	+	–
9	+ +	–	+ +	–	+	–	+	–
10	+	–	+	–	+ +	–	+ +	–
11	+ +	–	+	–	+	–	+ +	–
12	+ + + +	+	+ + +	+	+ + +	+	+ + +	+
Tetracycline	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +

** + indicates zone diameter between 6-8 mm, + + indicates zone diameter between 9-14 mm, + + + indicates zone diameter between 15-20 mm, + + + indicates zone diameter more than 20 mm and – indicates no inhibitory zone.

The following strains are used for testing the anti-bacterial and anti-fungal activity. *Helminthosporium oryzae*, *Corynespora casiicola*, *Aspergillus niger*, *Alternaria solani*, *Rhizoctonia solani*, *Pencillium notatum*, *Rhizobium japonicum*, *Bacillus subtilis*, *Xanthomonas oryzae* and *Pseudomonas viticola*. The purified compounds were dissolved in ethanol and tried at concentrations of 1000 and 50 ppm. The Whatman filterpaper discs with different compounds were plated asceptically on seed-nutrient-agar plates with different bacteria and fungi. Thiram and Tetracycline were used as standards for the screening of fungicidal and bactericidal activity respectively. The fungi were incubated for 7 days at 28±2°C and bacteria for 72 hr at 37±1°C. At the end of the incubation period, the diameters of the growth inhibition zones were measured.

All the compounds were found to be active. Their activity and mode of action varied depending on the position and substituents in the benzene ring. It is evident from fungicidal screening data that the activity increases when the substituent is in *ortho* position, which may be due to the *ortho* effect. Thus, it may be concluded that the increase of electron density on the benzene nucleus decreases the fungicidal activity. Nitro-substituted compound is less active than halogen-substituted compounds. The compound **12**, bis-2-[(3-pyridyl) vinyl] sulphone is showing maximum activity than the rest of the compounds. With the exception of compound **12** which is showing little activity, all other compounds are inactive at the minimium concentration.

Bactericidal screening data also shows that the *ortho* substituted compounds are more active than the *para* substituted compounds but only with an exception of *p*-fluoro substituted compound. The compound **11**, bis-[3, 4-(methylenedioxy) styryl] sulphone, which is inactive towards fungi, is active towards bacteria, and it shows minimum growth in negative bacteria, whereas it shows moderate growth in positive bacteria. The compound **12**, bis-2-[(3-pyridyl)vinyl] sulphone is having maximum activity at 1000 ppm and shows slight activity at 50 ppm. All other compounds are inactive at 50 ppm. Based on the screening results, it may be stated that when a phenyl ring is replaced by a heterocyclic ring like pyridine the activity increase enormously and it has been proved by the compound **12**, bis-2-[(3-pyridyl) vinyl] sulphone which has got maximum anti-bacterial and anti-fungal activity than the rest of the compounds in the series. The experiments provide some clue for finding out more active compounds in the series.

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Effect of penicillin and its interaction with IAA on the rooting of mungbean cuttings

Work from this laboratory has demonstrated that penicillin can mimic gibberellins in stimulating the synthesis of α-amylase[1,2] and ribonuclease[3] in embryoless rice (*Oryza sativa* L.) endosperm. Penicillin can also be as active as cytokinins in enhancing chloroplast pigment formation in intact rice seedlings[4] and etiolated mungbean (*Phaseolus aureus* L.) cotyledons[5] greening in the presence of light. The influence of penicillin in maintaining chloroplast pigments in isolated leaf discs has also been reported[6]. In view of the hormonal role displayed by penicillin in different plant systems, it was felt desirable to study the effect of penicillin on the rooting of cuttings which is basically an auxin-controlled phenomenon.

Mungbean (*Phaseolus aureus* L.) seeds were germinated in the dark in Petri-dishes lined with filter papers containing distilled water. From 5-day-old seedlings, 5-cm cuttings were made each containing hypocotyl, two primary leaves and with or without cotyledons. Penicillin (Benzopenicillin or Penicillin G) was used in 5 different concentrations ranging from 100 to 500 ppm either singly or in combination with IAA (10^{-4}M). For each treatment, 5 sets of vials were employed each with 10 cuttings and 10 ml of rooting solution which was changed at an interval of 2 days. The number of roots formed was counted after 6 days. The effect of penicillin on rooting was determined in both light and darkness and all the experiments were repeated four times.

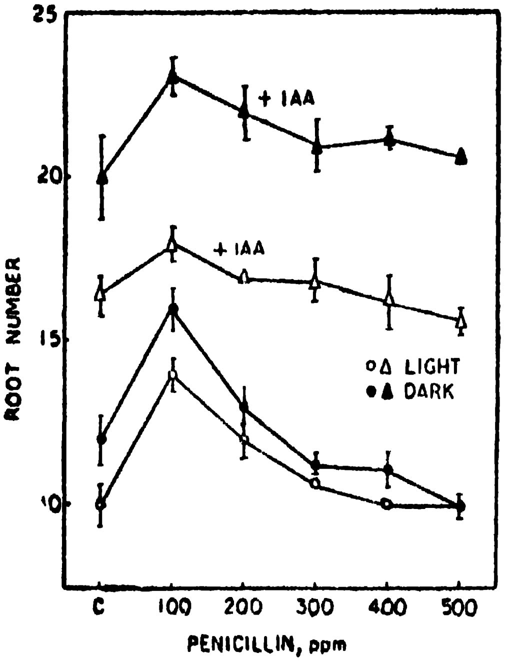

Fig. 1. Mean number of roots per cutting of mungbean in light and darkness when treated with penicillin and IAA singly and in combination with each other. Standard errors are given as vertical bars. Where error bars are not given, the error was smaller than the symbols used for graphing

Penicillin promoted rooting of cuttings when applied singly (Fig. 1). Of all the concentrations tested here, 100 ppm penicillin was found to be the most beneficial to induce rooting, a little less effective was 200 ppm, whereas 300 ppm and higher concentrations were not more effective than simple water. Rooting performance was shown to be better in darkness than in light. It has been previously observed that etiolation of the shoot is beneficial for the rooting of cuttings of a number of plants[7-10] and their observation regarding root-promoting effect of darkness over light supports our present findings. According to their opinion, prevention of photoinactivation of auxin is responsible for root promotion in darkness. On the contrary, the beneficial effect of light has also been described and the light effect has been attributed to the photosynthetic contribution of the leaves and the green stems of the cuttings[11]. In our material kept in light, the intact cotyledons served as an additional source of nutrients apart from photosynthates supplied by the leaves. The absence of any promotive effect of light was further borne out by another experiment in which the cuttings were exposed to light in 2 sets, one with and the other without cotyledons. In both cases, rooting behaviour was the same.

The interaction study shows that the increase in the number of roots per cutting in the presence of IAA in darkness was simply additive. In light, however, these values were less than additive and with higher penicillin dosages were even less than control (IAA 10^{-4}M), thus showing antagonism. From the present investigation, it thus appears that treatment with penicillin may be utilised with success for the vegetative propagation of cuttings.

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Some observations on the biology of *Atherigona Soccata* Rond. (Anthomyhdae : Piptera) on prosomillet in Bihar

The shoot fly (*Atherigona soccata* Rond.) is posing a limiting factor in the cultivation of prosomillet (*Panicum dichotomiflorum* Michx.) at Dholi and its adjoining areas during recent years. Few and scanty information are available on the extent of damage and biology of the pest on sorghum, maize and wheat[4] etc. No work appears to have been done on these aspects in relation to its attack on prosomillet under agro-climatic conditions of north Bihar. Studies on its bionomics and control were, therefore, undertaken at ARI, Dholi in 1980. The present paper, however, highlights the salient findings on the biology of the pest. The temperature and average R.H. during the course of investigations were 29.5±6.13°C and 63.32%, respectively.

The pest attacked the crop in two phases. Firstly, when the crop was in seedling stage lasting for about a month after germination and secondly at panicle-initiation stage. The maggots soon after hatching remained *in situ* for about 30-40 minutes and then crawled on the upper surface of the leaf blade. They moved along the leaf margin between the leaf sheath and the axis. After nibbling on the tissue for a while, they entered into the stem from the lateral side and fed on the growing tip of the central leaf. The infested plants at early stage of growth withered away forming dead heart, while its attach at panicle initiation stage resulted in white earhead formation. Rathore and Sengar[6] made similar observations on its nature of damage.

Female flies laid 29-40 eggs on the undersurface of the leaf margin during morning hours. Freshly laid eggs were smooth, cylindrical in shape and milky-white in colour measuring 0.94±0.12 mm in length and 0.32±0.02 mm in width. The anterior end of eggs turned yellowish at the time of hatching and eclosion of the larva took place on the dorsal side. The incubation period varied from 1-2 days. These observations confirm the findings of Pant and Kundu and Premkishore.[2]

The maggots soon after hatching were dirty white in colour measuring 1.8×0.2 mm in length and breadth, respectively. The maggots passed through four larval instars during growth and development and each instar lasted for 1.10±0.26, 2.48±0.58, 3.31±0.98 and 1.90±0.98 days, respectively. The average larval duration lasted for 8.79±1.69 days. The matured maggot was deep yellow in colour, measuring 6.80 mm in length, and provided with a pair of antennae and stout oral hooks on the cephalic segments. Joshi and Khan[3] made similar observations.

The matured maggot, thereafter, cut a hole in the stem and pupated inside. Freshly-formed pupae were light brown in colour and changed into deep brown latter. The length of the pupae ranged from 3.00 mm to 4.28 mm and were barrel-shapped being circular anteriorly. The pupal period lasted for 8±2 days.

The adults resembled house flies but were smaller in size and remained active throughout the day, mating 3-4 days after emergence. The longevity of male and female flies were 10±3 and 14±3 days, respectively. The finding are in agreement with Soto and Laxminarayana[5].

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A comparative evaluation of some pollen viability tests in ber

The information about pollen viability is a pre-requisite for the success of a breeding programme. The methods employed for testing the pollen viability include *in vitro* germination and stainability. The plant breeders prefer the latter method, because it is less time-consuming. In ber, pollen viability has been tested using both methods[1-6] but results are conflicting. The present study was undertaken to test the suitability of different stains as indicator of pollen viability in comparison with *in vitro* germination in ber (*Zizyphus mauritiana* L.)

Pollen germination was determined by dusting fresh pollen on 25% sucrose medium in cavity slides kept in moist petridishes for 24 hours at 30°C. For stainability 2% aceto-carmine, 1% aceto-orcein and 0.04% erythrosin-B were used. The staining was performed according to the procedure described by Conn *et al*[7]. In each test, approximately 1000 pollen grains were scored. In case of aceto-carmine and aceto-orcein, they were assayed as viable (stained) and non-viable (unstained); the relationship being reverse in case of erythrosin-B.

The data were arranged according to their rank (Table 1) and the correlation coefficients of simple and rank correlations were determined (Table 2). The correlation coefficients of pollen germination with different stains were negative and non-significant. The simple corre-

TABLE 1 : Pollen germination and viability in various ber cultivars

Name of Cultivar	Pollen Germination (%)	Pollen viability (%)		
		Aceto-carmine (2%)	Aceto-orcein (1%)	Erythrosin-B (0.04%)
Ponda	77.00 (1)	58.95 (9)	81.20 (4)	53.59 (10)
Gola	74.10 (2)	70.76 (5)	78.80 (5)	91.65 (2)
Umran	70.80 (3)	74.17 (4)	76.40 (7)	83.86 (3)
Sonari-5	65.30 (4)	67.70 (7)	73.80 (9)	66.30 (7)
Seo	64.80 (5)	81.40 (1)	78.80 (6)	61.10 (9)
Kathaphal	52.30 (6)	30.27 (10)	35.20 (10)	92.27 (1)
Reshmi	51.60 (7)	69.80 (6)	74.90 (8)	65.30 (8)
Banarasi Karaka	27.80 (8)	79.80 (3)	84.80 (3)	90.40 (4)
Sandhura Narnaul	23.50 (9)	66.20 (8)	97.60 (1)	80.30 (5)
Kaithli	22.50 (10)	81.00 (2)	94.50 (2)	75.20 (6)
Illaichi	0.00 (11)	0.00 (11)	0.00 (11)	0.00 (11)

Values in paranthesis indicate rank order.

lation shows stainability with aceto-carmine is closer to pollen germination but rank suggests erythrosin-B to be so. Aceto-carmine and aceto-orcein showed high correlation but since their correlation with germination was poor, they can not be taken as reliable indicators of pollen viability. Erythrosin-B has successfully been used for assaying cell viability[8], but its poor correlation with pollen germination in the present case renders it unsuitable for pollen viability studies.

TABLE 2 : Correlation co-efficients of pollen germination with pollen viability using different stains and among various stains

	Aceto-carmine	Aceto-orcein	Erythrosin-B
Pollen germination	-0.1774 (-0.2485)	-0.3702 (-0.3939)	-0.2295 (0.0909)
Aceto-carmine	—	0.8039 (0.2970)	-0.2833 (-0.1270)
Aceto-orcein	—	—	-0.3063 (-0.1394)

Values in paranthesis indicate rank correlation

The pollen germination ranged from 0 in cv. Illaichi to 77% in cv. Ponda (Table 1). Desai and Patil[3] have observed complete sterility in cv. Illaichi and 71.6% pollen germination in cv. Umran which is in conformity with our results. The pollen fertility reported by Singh and Misra[5] in cv. Gola (78.50%) is very close to our observations but their data in cv. Banarasi Karaka (83.95%) deviates drastically from that in the present case.

The pollen germination in 20% sucrose was observed to be about 45% in cv. Umran, Kaithli and Sonari-5[4]. The media with 15% sucrose[2] and 30% sucrose[1] are recommended for testing pollen viability. So the differences in the pollen germination can be attributed to the medium used.

From the present studies, it can be concluded that for testing of pollen viability in ber the *in vitro* germination remains to be the most accurate and reliable method.

The work was carried out under ICAR scheme on arid zone fruits.

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A Hematological study of Marbled Balloon frog *Uperodon systoma* Schneider

Hematology of *Uperodon systoma* has been reported for the first time in this study. It is a burrowing frog available in plenty during the monsoons. Observations were made on these frogs available in Bhubaneswar located 25 m above sea for a period of two years (1979 and 1980). Blood samples collected in heparinized capillary tubes were centrifuged and hematocrit percent (packed cell volume) was determined by a hematocrit-measuring scale. Total erythrocyte and leucocyte counts were made according to the method described by Dacie and Lewis[1] by a hemocytometer, using amphibian saline (0.65%) with gention violet as RBC diluting fluid and 0.1 N HCl with neutral red (1% in 0.1 N HCl) as WBC diluting fluid. Hemoglobin concentration was determined in a hemometer. Leucocyte differential count was made by staining a thin smear with Leishman's stain. The pH of blood was determined with pH paper with fractional range between 6.0 to 8.0 (Merck, Germany).

Sexual dimorphism in this frog was reported for the first time in most of the hematological parameters (Table 1). WBC total count, hemoglobin gm%, hematocrit percent and neutrophil percent were significantly higher ($p<0.05$) in males than females. The difference in other hematological parameters between males and females were insignificant.

TABLE 1 : Hematological averages for *Uperodon systoma* (10 individuals in each sex)

Blood value and cell type	Sex	Mean ($\bar{X}$)	S. E. of ($\bar{X}$)
Erythrocytes in million (per mm³)	♂	1.23	0.22
	♀	1.72	0.12
Leucocytes (Per mm³)	♂	22220	1783.98
	♀	16100	1072.58
Hemoglobin (in gm/100 ml.)	♂	12.14	0.34
	♀	9.02	0.66
Hematocrit (in % cell)	♂	42.3	3.25
	♀	34.2	1.67
pH	♂	7.3	0.03
	♀	7.3	0.03
Lymphocyte (%)	♂	40	2.64
	♀	54	2.62
Monocyte (%)	♂	11	0.97
	♀	13	1.85
Neutrophil (%)	♂	48	3.18
	♀	32	2.48
Eosinophil (%)	♂	0.7	0.26
	♀	0.8	0.39
Basophil (%)	♂	0.1	0.1
	♀	0.1	0.1

The erythrocytes are elliptical in shape with centrally located nucleus. The average size of long and short axes of erythrocytes were 14.43 μ and 10.88 μ respectively. The spindle shaped thrombocytes had an average long and short axes of 11.42 μ and 4.77 μ respectively. The following five types of leucocytes with corresponding mean diameter sizes, given in the parenthesis were noted in *U. systoma* : Large lymphocyte (9.77 μ), Small lymphocyte (5.88 μ), Monocyte (7.77 μ), Neutrophil (8.88 μ), Eosinophil (9.62 μ) and Basophil (7.22 μ).

Reports on the hematology of amphibians of India is very scanty[3-5]. Amphibian blood cells are of mammalian type except that the erythrocytes are oval and nucleated. Besides the characteristic oval red blood cell shape, varying degree of irregularities ranging from pointed at one or both ends to cone shape, were observed. Small polychromatic red blood cells were also observed occasionally. Lymphocytes are spherical in shape with a large nucleus occupying almost the entire cell. Occasionally a small ring of cytoplasm around the nucleus could be discerned. Monocytes were easily distinguished from lymphocytes by their kidney shaped nucleus. Polymorphonuclear neutrophils did not appear granulated. The nucleus usually appeared in an eccentric position. Eosinophils showed bright red with thick round granules against a light pink cytoplasmic background. Basophils had a large round centrally placed dark blue stained nucleus with pin-headlike darkly stained granules. Only two basophils could be observed in this study. Thromobocytes, the lower evolutionary counter part to human platelets, appeared as small refractile bodies. Since hematology of this frog has been reported for the first time in this report the results depicted in this study is basic in nature and further studies are needed to be done.

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Effect of phenylhydrazine hydrochloride on the blood sugar level of Lata fish (*Channa punctatus*)

Earlier studies indicate a hypoglycæmic effect of hydrazine on different animals[1,2]. The fasted dogs injected with hydrazine show within 90 min after injection a hypoglycæmia which continues till death of the animals[3]. On the other hand, hydrazine can produce hyperglycæmia[4]. Poisoning with phenylhydrazine causes a long-term hyperglycæmia[5]. O'Brien *et al.*[6] have also shown elevated blood sugar level with different hydrazine compounds. Isoniazid increases the level of blood sugar[7]. But hydrazine treatment in both dogs and rabbits induces hypoglycæmia. It appears, therefore, that both hypoglycæmia and hyperglycæmia occur in higher animals after treatment with hydrazine and its derivatives. Moreover, depletion of liver glycogen has been shown by phenylhydrazine injection in dogs. In course of investigations on the effect of different doses of phenylhydrazine hydrochloride (PHH) on various physiological parameters in Lata fish, it has been found that a decrease in glycogen content of liver takes place after PHH injections[8]. This observation prompted us to extend our investigations on the effect of PHH on the blood sugar level of Lata fish (*Channa punctatus*), since, to our knowledge, such study has not been reported on this type of fish. Based on our observations[8], a suitable dose of 4.0 μg of PHH per gram of body weight of fish was selected for the present study.

The Lata fishes of 25-32 gram body weight were divided at random in different groups for the experiments. Each fish was maintained in 1 litre of tap water in glass jar at 25°C±1°C, and the medium was changed every day. Phenylhydrazine hydrochloride [Loba-Chemie Wien-Fischamend (Austranal-Praparate)], dissolved in 0.65% NaCl solution, was injected intraperitoneally at the dose of 4.0 μg/gram of body weight of fish on the zero day, and on the 4th, 8th and 12th days. The injected volume was within 0.1 ml. The control fishes received the same volume of 0.65% NaCl solution. All the experimental fishes were starved during the experimental period. The Lata fishes were killed for drawing blood on the 4th day after the last injection, i.e. on the 4th day in case of single injection, on the 8th day in case of two injections, 12th day in case of three injections and 16th day in case of four injections. Blood was drawn carefully avoiding the hemolysed blood. Hemolysed blood was not generally found after four days of PHH injections. The blood sugar level was estimated by following the method of Nelson-Somogyi[9,10]. The results were statistically analysed by using student t-test. Each treated or control group consisted of 20 fishes.

The blood sugar level of the fasting control Lata fishes during the experimental period varied from 77.50 to 83.51 mg/100 ml of blood. Compared to the respective control, the blood sugar level was increased by a single and repeated injections (2, 3 and 4 injections, each at four days interval) of PHH at the dose of 4.0 µg/g (Table 1). The increase in frequency of PHH injections from one to two or three injections was accompanied by an increase in blood sugar level. When the fishes were given four injections of PHH, the elevated blood sugar level was found to be about the same as observed after two injections, but the level was higher in comparison to the level obtained after a single injection of PHH. There was no statistical difference in results with respect to increase in blood sugar level among the two, three and four injections groups.

TABLE 1 : **Effect of phenylhydrazine hydrochloride (4 µg/g, single injection, and repeated injections - at four days interval) on blood sugar level (mg/ 100 ml blood) of Lata fish (*Channa punctatus*). The day of first injection was taken as zero day. The animals were starved during the experimental period. Each group consisted of 20 fishes.**

No. of injections	Day of blood drawing	Control Mean ± S.E.	Treatment Mean ± S. E.	P value (Control-Treated)
1	4	78.90 ± 4.13	98.59 ± 3.49 (A)	<0.01
2	8	83.51 ± 3.80	110.21 ± 4.00 (B)	<0.001
3	12	78.67 ± 4.70	116.36 ± 5.00 (C)	<0.001
4	16	77.50 ± 4.20	110.71 ± 4.30 (D)	<0.001

S. E. = Standard error. t-test probability differences between different treated groups : A-B = $P < 0.05$; A-C = $P < 0.01$; A-D = $P < 0.05$; B-C = NS ; B-D = NS ; C-D = NS.
NS = Not significant.

It is evident that the elevated blood sugar level in Lata fish after single or repeated injections of PHH remained below 120 mg/100 ml of blood. For this reason, this rise of blood sugar may not be termed as hyperglycæmia. It can be pointed out that the control Lata fishes in fasting condition during the period of experiment showed no significant variation in blood sugar level. Similar reports have been made by others[11]. It is obvious that increased blood sugar level in Lata fish after PHH injections may be due to glycogenolysis in liver, since it has been found in course of our investigations that the liver glycogen content declined significantly after PHH injections[8] thus contributing to the rise of blood sugar level. The PHH-induced asphyxia due to low hæmoglobin content may be one of the causes for increased blood sugar level in Lata fish. This may be assumed by the fact that asphyxiation hyperglycæmia occurs in fresh water fish[12]. It may be a fact also that rise in blood sugar concentration in PHH treated Lata fish is the result of reduced utilization of blood sugar due to the reduction in erythrocytes number by PHH treatment. It is also known that insulin level in blood is reduced by hydrazine treatment[13]. In our treated fish, it is difficult to explain at present whether or not PHH elevates the blood sugar level by affecting the insulin level of blood. Whatever may be the mechanism involved, there is a definite relationship between the reduced liver glycogen content and a concomitant enhancement of blood sugar level in PHH injected Lata fish.

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Sexual dimorphism in the cyprinodontid weed fish, *Oryzias melastigma* (Mc Clelland)

Sexual dimorphism in fishes is mostly associated with variation in length of fins, genital papilla and colour pattern[1-8]. The present paper deals with the sexual dimorphism of *Oryzias melastigma* (Mc Clelland) under family Cyprinodontidae which is not reported before.

This tiny weed-fish is most common in West Bengal, Kerala, Tamil Nadu and Bangladesh[9] and is generally found in gutters, paddy fields, derelict ponds, foul waters and also in brackishwater areas.

A number of juveniles and adult specimens have been collected from different water areas of gangetic West Bengal during the period of August, 1982 to July, 1983.

From the intensive study of the specimens of *Oryzias melastigma* (100 numbers of specimens of each sex were studied and size ranges from 23 to 29 mm in male and 21 to 30.5 mm in female), the authors come to conclude that this species shows pronounced sexual dimorphism (Fig. 1) in their fin features. The anal and the dorsal fin of males (Fig. 1b) are filiform and larger than the female (Fig. 1a; Table 1) ones where fins are unfiliform, smaller and with more or less rounded outer edge.

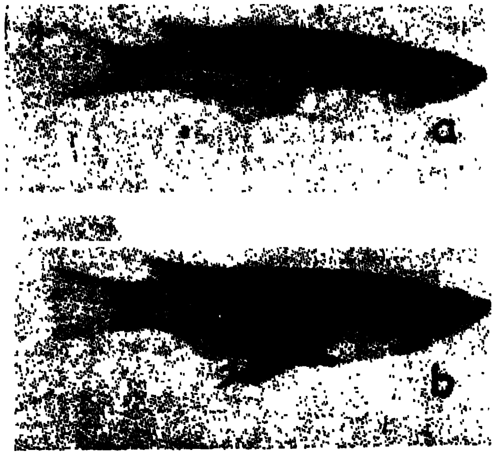

Fig. 1. *Oryzias melas*[illegible]McClelland) : Lateral view of female (a) and male (b).

TABLE 1 : **Sex, total length, height of the dorsal fin and anal fin (mean ± S.E.) in 20 fishes of each sex group**

Sex	Total lenght (mm)	Height of the dorsal fin (mm)	Height of the anal fin (mm)
Male	25.47 ± 0.36	4.93 ± 0.09	5.67 ± 0.10
Female	26.02 ± 0.48	3.69 ± 0.09	3.66 ± 0.09

A few authors[9-10] have given the description of *Oryzias melastigma* and only mentioned filiform rays of anal fin in some of the specimen as individual variations. But the variation of dorsal fin is not mentioned.

The type specimen described there was not given the sex. It seems that the described specimen was female one and they considered male-fin features as a variation from the described female type.

The present investigation reveals the diagonostic features of anal and dorsal fin in male and female. In other taxonomic characters, both the sex do not show any difference.

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Effect of artificial saline water on methane production

The need for alternative energy supplies is increasingly becoming apparent. Our fossil fuel reserves will eventually be distributed and are becoming too costly for many countries that must import them. The present energy generating systems in the developing countries depend largely on such local resources as wood or dung. Of these, dung is underexploited. Dung can be conveniently used for methane production by anaerobic digestion. The gas thus produced has several uses in the form of mechanical, heat and light energies. Since dung and water form the basic materials for methane production, the quality of water used in production of biogas assumes a great importance and the ground water in arid and semi-arid region generally contain high amount of salt. The present study was conducted to know the effect of artificial saline water on methane production.

The combination of NaCl and $CaCl_2$ in equal proportion was used in preparing saline water electrical conductivity (EC) levels, viz. control (distilled water), 1, 2, 4, 6 and 8 mmhos/cm at 25°C. A portion of 600 g cattle dung and saline water at different levels were mixed on equal proportions and filled in winchester bottles. Provision was made to collect the gas by downward displacement of water. The bottles were sealed soon after introducing the treated mixtures. The gas thus produced was measured with the help of measuring cylinder and methane was tested by burning it.

TABLE 1 : Effect of artificial saline water on methane production

Treatment	pH of the main media	Time taken to produce methane (days)	Quantity of methane produced (ml)	Per cent increase or decrease over control
Control	7.75	13	11,565	0.0
1 EC*	8.40	13	36,750	+223
2 EC	8.30	11	26,215	+127
4 EC	8.30	13	1,300	-89
6 EC	8.00	—	@	-100
8 EC	8.05	—	@	-100

EC* : Electrical conductivity (Milli-mhos/cm) at 25°C

@ : Did not produce any gas during the duration of experiment.

The results of the experiment are presented in Table 1. Higher amount of salinity, i.e. 6 EC and 8 EC was ineffective in producing any methane gas. Higher salt concentration curtailed the activity of methanogenic organisms, fully resulting in the cessation of gas production may be a probable reason. The results are in conformation with the findings of Pfefter[1]. An increase in EC is associated with a decrease in the amount of gas produced. 1 EC solution gave 36,750 ml methane (223% moreover control). There was a reduction in methane production (26,215 ml) when the EC was increased to 2 (127% moreover control). Further, when EC was increased to 4 only 1300 ml of methane gas was produced (89% less than control). The other two treatments were totally inefficient in producing any methane gas. Presently, it appears that 1 EC saline water can be effectively utilized as it goes 223 per cent more methane than using distilled water (11,565 ml). Under situations where saline water is available for use, such waters can have up to 2 EC.

Any higher salinity would reduce the efficiency of methane production. This indicates that salts at lower concentration (<2EC) stimulated the growth and activity of methanogenic organisms as reflected in higher methane production. The present study clearly indicates that salt concentration beyond the level of tolerance affects the methanogenic organisms possibly by reducing water potential and in turn causing severe reduction methane production.

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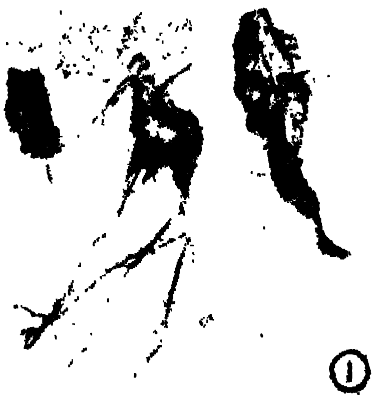
Occurrence of root-knot nematode in Congo jute

Congo jute (*Urena lobata* L.) is a member of Malvaceae which yield a fibre from its stem. The plant is found in several countries in the warmer regions including India.

Urena sp. is highly resistant to attacks by nematode[5]. *Heterodera marioni* (now called *Meloidegyne incognita*) was reported from *Urena* in Zaire (Belgian Congo)[4]. The resistance of *Urena* to nematodes that attack kenaf in highly infested soils is observed in Ghana[1]. There was no evidence of nematode attack on *Urena*, grown on nematode-infested sandy soils in North Florida, although kenaf in adjoining plots had heavy attack[3].



①

Fig. 1. Composite galls in the tap root

At the main farm of the Jute Agricultural Research Institute, West Bengal, some plants of *Urena lobata* of Block No. 13 had the presence of galls in the anterior part of the tap root as well as lateral roots. The galls on the tap roots were bigger in size and composite in nature (Fig. 1). Most of the swellings on the roots were within the range of the 2-6 cm depth from the soils surface, though *Urena* sp. has a tap root of about 20-25 cm in length and a secondary root-system which is lateral and running, the axes of which decrease in depth.

The galls on the roots are evident in the field when the plants attain 4 months croppage, i.e. November onwards. In the younger plants, galls were hardly observed.

Examination of the galls when teased under magnification (× 36) of the microscope showed the presence of egg-masses in different phases of their development and mature females of nematodes.

The nematodes belong to the genus *Meloidogyne* and they are identified as *M. incognita* (Kofoid and white) Chitwood[2]. This is the first report of *M. incognita* on *Urena lobata* L. from India.

The authors are thankful to the Director, J.A.R.I. for providing facilities.

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Leaf blight of large cardamom caused by *Colletotrichum* sp.

Large cardamom (*Amomum subulatum* Roxb.) is an important cash crop of Eastern region of India and Kerala. During July-August (1982) some plants in a kitchen garden near Bihar University campus, Mazaffarpur were found heavily infected with a blight disease. The pathogen was isolated from diseased leaves, grown on Potato-dextrose agar slants, and identified as *calletotrichum* state of *Glomeralla cingulata* (Stonem.) Spauld. and Schrenk by Dr. J. E. M. Mordue of Commonwealth Mycological Institute, Kew, England (IMI 273012).

Pathogenicity of the fungus was established after completion of Koch's postulates. Leaves were first injured by sterilized needle, sprayed with spore suspension and covered with moist polyethylene bags. The characteristic disease symptoms appeared four days after inoculation.

Initially light brown irregular spots appeared along the margins of leaves. These spots gradually advanced towards the midrib and turned reddish brown. At the advanced stage of disease, the leaf margin showed frilled appearance and the whole leaf dried up.

A thorough perusal of literature[1] reveals that the blight disease of *Amomum subulatum* caused by *Colletotrichum* sp. is an unrecorded disease and hence, is being reported for the first time from India.

Our thanks are due to Dr. Mordue of CMI, Kew, England for confirming the identity of pathogen.

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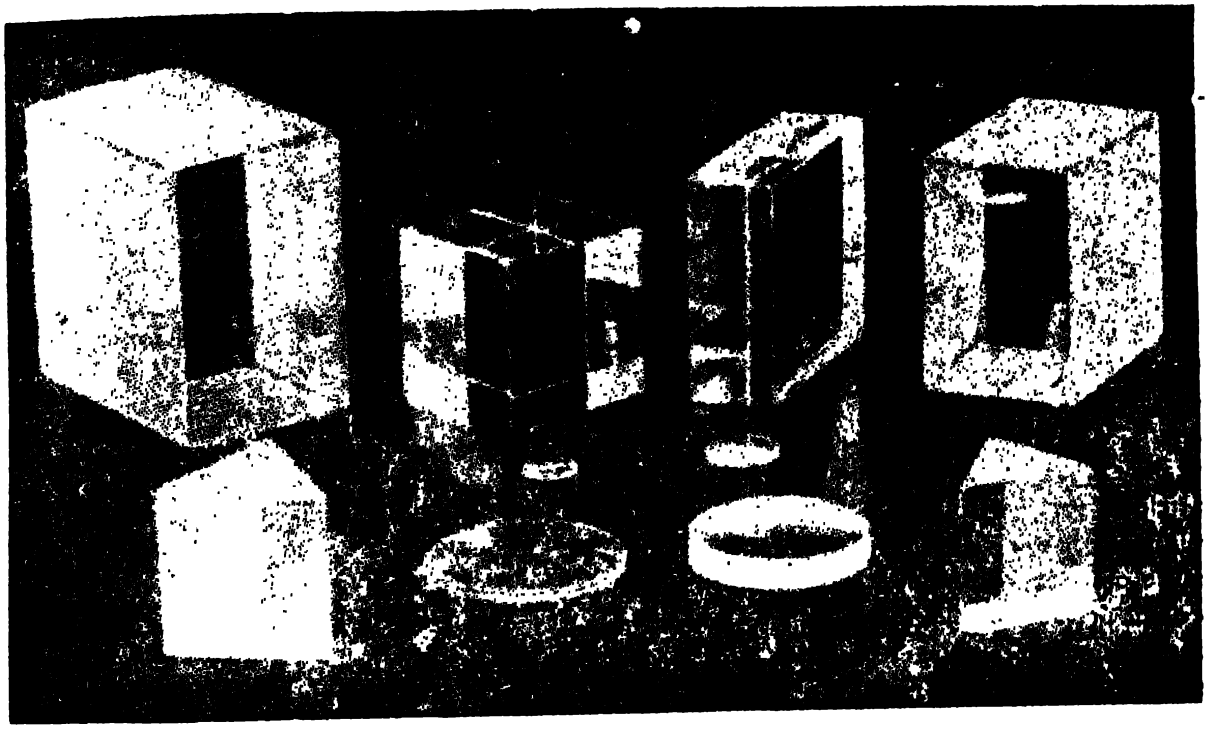

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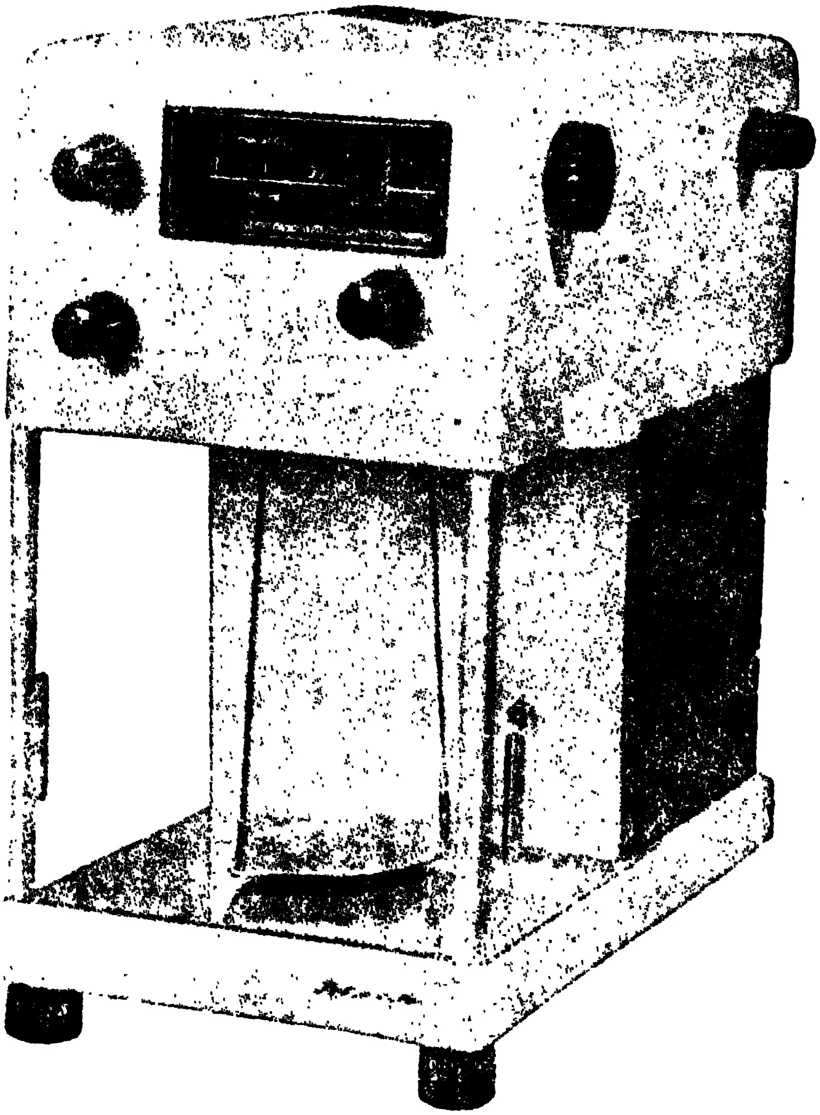

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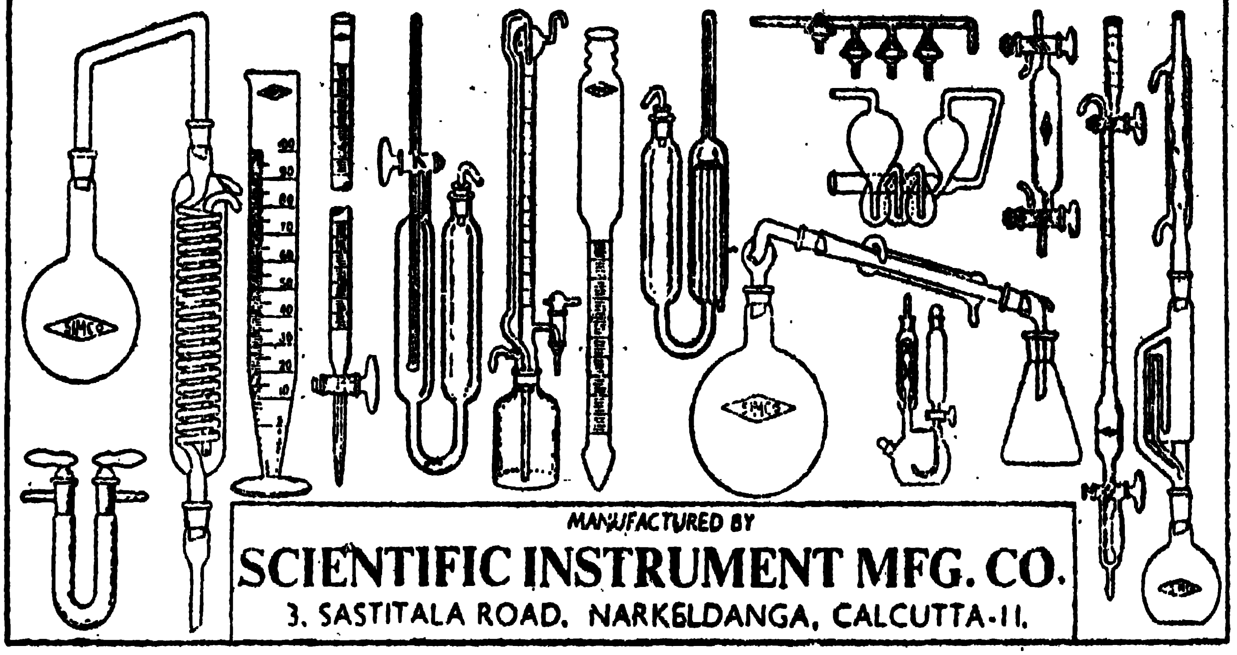

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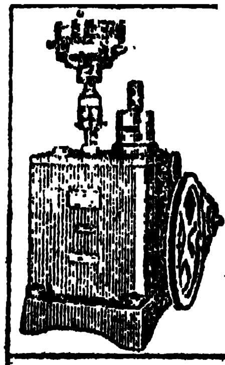

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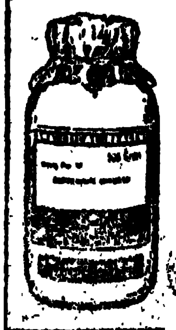

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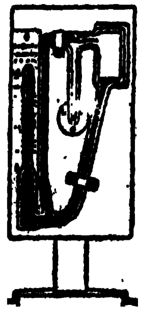

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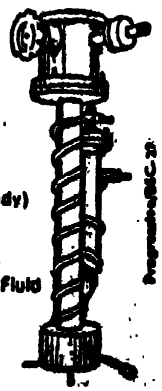

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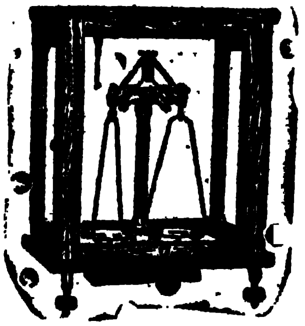

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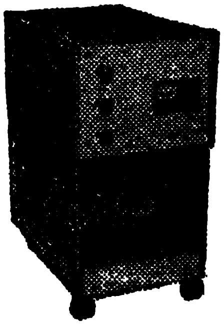

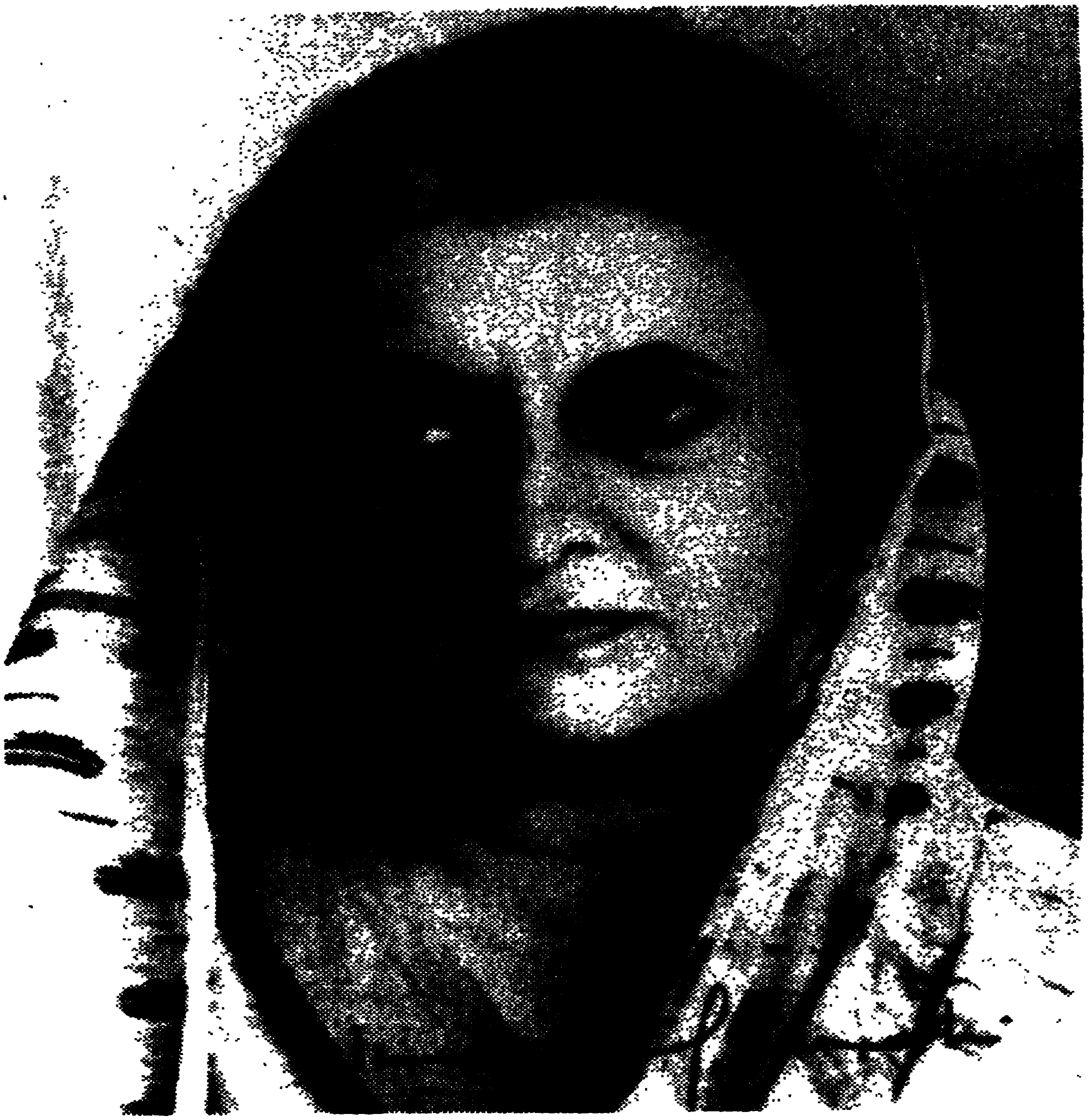

Srimati Indira Gandhi

Born November 19, 1917 *Died October 31, 1984*

SCIENCE & CULTURE

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HOMAGE TO SRIMATI INDIRA GANDHI

WE pay our homage to the departed Prime Minister, Srimati Indira Gandhi whose assassination has been a shock to the entire nation. The scientific community has particular reason to be mourning her loss because she had not only carried on the scientific policy of the Nehru era but also extended it to new areas. She believed in the liberating influence of science, and saw it as an ally of social justice.

Science has been recognised as a pursuit of knowledge for its own sake, technological inventions have used the fruits of that wisdom to the material needs of our civilisation. In the last few hundred years their impact on society has been formidable, and as we stand on the door-steps of the 21st century, science and technology seem to dominate the way we live, work and think. A new relationship has also emerged between science and the people at the helm of political affairs. A head of government now has the power to encourage or hinder the free development of science in a way unimaginable during the time of J. C. Bose and P. C. Ray.

As late comers in the race, our future depended a great deal on the right kind of decisions taken at the early stage when our science and planning policies were being formulated. Fortunately the initial thurst was towards a rational point of view. Nehru even when he was vaguely thinking about the future could instinctively feel that 'India must lessen her religiosity and turn to Science'. Later the concept of national planning grew, much of it in the pages of this journal, led by the late Professor Meghnad Saha. However, Nehru's faith in science was evident in the Scientific Policy Resolution of 1958, which became a kind of national charter for our scientists. To produce worth-while results the goal has to be clear-cut. Thanks to the early beginning in the right direction, we now have a significant scientific infrastructure in terms of number, range of skill and quality.

Nehru did not live to see India being recognised as a nuclear country or entering the space age. When Mrs. Gandhi came to the scene we were ready for more ambitious ventures—like exploring the deep ocean-bed, exploring the south pole, putting up multi-purpose satellites, even sending a man into space. The spectacular event of viewing Rakesh Sharma talking to the Prime Minister from outer space had a tremendous psychological impact on the younger people.

Mrs. Gandhi's Technology Policy Statement of 1983 made it very clear that for a country of our size and endowments, self-reliance is inescapable. It laid emphasis on attaining technological competence, particularly in strategic and critical areas, making the maximum use of indigenous resources. She reminded the delegates at the Tirupati session of the Indian Science Congress of the famous words of Le Corbusier: "There is no such thing as a primitive man; there are only primitive means". To the question of whether we can afford new techniques like micro-computers she said—"can we afford to be stuck with obsolete ones ?" She agreed with many experts that village mini computerisation should be given the highest priority.

Mrs. Gandhi had been called a pragmatist. But she was also capable of evolving a philosophy which linked the present with the future on the one hand and with the past on the other. Her well known speech at the Stockholm conference of the United Nations bears testimony to this :

"Must there be a conflict between technology and a truly better world or between enlightenment of the spirit and a higher standard of living ? Foreigners sometimes ask a very strange question, whether progress in India would not mean a diminishing of her spirituality or her values. Is spiritual quality so superficial as to be dependent upon the lack of material comfort ?"

Talking of pollution in the same speech she focussed the peculiar dilemma of the Third World countries. The rich nations look condescendingly at our continuing poverty. They also warn us against their methods. We have no intention of degrading our environment any further, yet the grim poverty of a large number of people stares us in the face. "Unless we are in a position to provide employment and purchasing power for the daily necessities of the tribal people and those who live in or around our jungles, we cannot prevent them from combing the forest for food and livelihood, from poaching and from despoiling the vegetation. When they themselves feel deprived, how can we urge the preservation of animals. The environment cannot be improved in conditions of poverty. Nor can poverty be eradicated without the use of science and technology".

With the tragic and sudden end to a life so sympathetic to the cause of science—the entire scientific community in this country has lost a friend and patron. □

Santimay Chatterjee

FUTURE APPROACHES TOWARDS INTEGRATED MANAGEMENT OF PESTS IN DRYLANDS

N. C. JOSHI* and N. K. SANGHI**

IN the present paper, the term pest management has been taken into its wider sense which refers to the control of weeds insects as well as diseases. The magnitude of damage due to these pests is well known and has been amply quantified[1-2]. Similarly, the salient findings which emerged out of the work carried out in the dryland project and elsewhere have also been sufficiently documented[3-4]. Attempts have been made to bring out some of the reactions of farmers to the above recommendations in order to identify the priority areas for future research.

Management of Weeds

During the last decade sufficient research information has been generated on the mechanical as well as chemical methods of weed control particularly for the annual weeds of *kharif* season crops. It was clearly established that the first weeding operation *must* be carried out as early as possible after the sowing (i.e. at about 20-25 days stage in case of cereals having 90-100 days duration). By and large, this recommendation has been well appreciated by the farmers. However, the mechanical weeding approach could not satisfactorily meet the problem in situation where the labour is busy with alternate jobs and also where the field is too wet due to continuous rains and heavy soils. The following examples would illustrate the point.

(a) In the red soils of Telengana region, very little attention is paid to drylands particularly in villages where irrigation intensity is more than 10 per cent. During *kharif* season, the farmers are heavily occupied for field operations in irrigated paddy crop. The improved dryland technology in such situations did not attract the farmers' attention primarily because of the clash for labour demand between hand weeding in drylands and transplanting in paddy.

(b) In the uplands of Orissa, Bhubaneswar, etc. the weeds are controlled through the use of only hand tools. Traditionally, only one operation is done by the farmers. The improved technology with dwarf genotype and fertilizer use could spread only in a limited area because of its requirement of additional weeding operation. The system of line-sowing (which is meant to minimise the labour requirement for weeding) could not attract the farmers' attention due to practical difficulties at sowing time (since a very little time is available for sowing operation due to continuous rains).

(c) In the wet vertisols of Madhya Pradesh, Maharastra and Andhra Pradesh, a large percentage of area is kept fallow during kharif season. The trails have consistantly proved that under the improved management, it is highly advantageous to take a kharif crop in these lands rather than fallowing. However, the attempts to introduce the new technology in these lands met with only a partial success. In many years, the clear days for weeding operations during July August are very limited with the result many farmers are forced to keep a sizeable area under fallow inspite of the fact that they are convinced about the need for raising the crops during *kharif* season.

The mechanical weeding approach has also shown its limitation in situations where perennial weeds are severe. Traditionally, deep ploughing during summer season has been the usual practice, otherwise, these weeds are required to be controlled through a repeated shallow tillage (by keeping the land fallow during kharif season). Both of these existing

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approaches have their own limitations. Deep ploughing is practised mainly in cases where the farmer owns bigger holdings and therefore, possess his own 'heavy duty bullocks'. Similarly, the kharif fallowing approach, though controls the weeds, suffers due to low productivity and inefficient use of rain water.

The above examples illustrate that there is a need to introduce herbicide approach at least in selected situations. Although a lot of information is already generated, the following points may be considered for further refinement of the herbicide technology.

(a) In majority of cases, the herbicides are required to be applied around the sowing time. From the practical view point, it may be better if suitable herbicides are identified which can be applied in the standing crop at about 3-4 weeks stage [as in case of 2, 4-D and Isoproturon (N, N-Dimethyl-N-4-isopropyl-phenyl urea) in wheat]. Such a method would provide high flexibility to the farmer so that he may use either herbicide or mechanical measure, depending on the seasonal conditions or the labour availability.

(b) Most of the presently available herbicides are required to be applied through high-volume sprayers which lead to practical difficulties with regard to the availability of water as well as labour at the time of sowing operation. It may be useful if suitable nozzels of spray and appropriate formulations of herbicides are identified and developed, so that they can be used with low volume sprayers. The granular formulations of the herbicide would further be helpful if they can be applied with the last ploughing operation. The practice of broadcasting the mixture of herbicide and sand (as being currently followed by the farmers of Haryana and Punjab for the control of weed in wheat crop) need also be evaluated and refined.

(c) In many cases, the herbicides are required to be incorporated in soil before sowing operation. The trials, which have been conducted at the research stations, have usually used the implements like disc harrow, rotavator, etc. for efficient incorporation. Very often an extra tillage operation has also been done to achieve the purpose. It may be useful to verify whether the effective incorporation of herbicide could also be done by using the existing implements like *desi* plough, blade harrow, etc. and whether it could be achieved as a part of the on-going field operations rather than doing an additional operation.

(d) A particular attention is required to find out suitable herbicide for perennial weeds. The exploratory trials in black soils of Andhra Pradesh have shown that Glyophospate [N-(phosphonomethyl) glycine] herbicide is very effective for the existing perennial weeds. The farmers have shown their willingness to buy this herbicide even if the cost is 'high'. There is a need to test its potential in other areas where such weeds are severe.

Management of Insects

In case of insect control there is unfortunately a heavy reliance on the use of chemicals despite the fact that the concept of IPM (integrated pest management) has been well recognized. This is primarily because field based information on other means of insect control, viz., cultural, biological, etc., are available only in limited situations. The integrated approach for insect management has a special significance for dryland agriculture, as it helps in reducing the total cost of cultivation and in improving the stability of yield at low level of management. In future, there is an urgent need to consider the following points for developing the integrated systems.

Avoidance of insects through cultural practices: The practices like time of sowing/planting, method of fertilizer placement, duration of genotype, row spacing, etc., have been found to have a direct bearing on pest problem. Through a proper choice of the above practices, the sensitive stage of the crop can be avoided from peak build-up of the pest[4].

The following examples would illustrate the point.

(a) In case of sorghum in Hyderabad region (Table 1), early sowing or use of short-duration genotype (under delayed sowings) can evade the problem of earhead bug (*Calocaris* ungustatus).

TABLE 1 : Effect of sowing date and duration of genotypes on avoidance of earhead bug in sorghum in red soils of Hyderabad (1978)

Sowing time	Earhead bug/plant	
	CSH-6	CSH-5
May—25	5.6*	8.0*
June—15	6.9*	36.1**

*Flowered during August 16-26.

**Flowered during the second week of September.

(b) Similarly the placement of fertilizer (Table 2) helps in avoiding the problem of shootfly (*Atherigona soccata*) in sorghum through the rapid development of seeding vigour[5].

TABLE 2 : Effect of different methods of fertilizer application on shootfly incidence in sorghum at Hyderabad

Fertilizer placement	Shootfly incidence
Broadcast	25.4
Band placement	8.3

*A dose of 10 kg nitrogen and 30 kg P_2O_5 per ha was applied in both cases.

There is a need to understand the precise role of such practices for other major pests like aphids in mustard, pod borer in redgram, stem borer in sorghum, etc.

Capitalizing on natural parasitoids : A number of studies have brought out that natural parasitoids play an important role in minimizing the pest damage[6-7]. Preliminary experience at Hyderabad has revealed that an egg parasitoid (*Trichogramma sp.*) and a larval parasitoid (*microplitis sp.*) play important roles in controlling the semi-looper pest in castor. Experience at the biological laboratories in Mahaboobnagar has brought out that these natural parasitoids are less active during the month of June. Later the egg parasitoid becomes active during July whereas larval parasitoid becomes active during August. Therefore, it has interestingly been observed that a delayed-sown castor (i.e. during mid-July) completely avoids the semi-looper problem[4]. In case of early-sown crop (Table 3), the natural parasitoids are not able to control the pest due to their slow activity.

TABLE 3 : Effect of sowing date on the build up of semi-looper pest on early and delayed-sown castor at Hyderabad —1982

Period of observation		Av. No. of larvae / 10 sq m	
		Early sown	Delayed sown
July	1-15	Nil	Nil
July	16-31	16	0.7
August	1-15	61*	0.2

Early sown : June 1-15 ; delayed sown : July 1-15.

* Crop would have failed without pesticide use.

Understanding of pest-weather relationships : This is perhaps the most important aspect of integrated pest management in dryland agriculture. Many of the pests seems to have a definite relationship with weather conditions, e.g. pod borer in redgram as well as aphids in mustard are found to be highly connected with cloudy conditions at flowering time.

Certain pests are directly related with atmospheric drought. In Andhra Pradesh, the pests like leaf webber in groundnut, becomes severe during years when there is a long break in rainfall. Similarly Jassids and Thrips in chillies are also found to be associated with long gaps in rainfall during *kharif*. In such crops, the low yield during dry years is mainly because of the indirect effect of drought rather than due to the soil moisture stress. The pest-affected crop does not properly recover even when the rainfall revives subsequently.

A thorough understanding of pest weather relationship would thus help in taking timely control measures, avoiding the indiscriminate use of pesticides and eliminating residue, pollution and insect resistance problems against pests. It would be appropriate to mention that a lot can be learnt on this aspect out of the traditional wisdom existing with the farmers in different areas.

It is being now recognised that higher priority must be given in the dryland project to develop Integrated Pest Management for the major pests. It has been well recognised that rapid progress can be achieved through a systematic surveillance programmes which may help in understanding the behaviour of the pests in relation to agronomic practices, weather condition, etc. and also in determining economic thresholds of pests in the farmers' fields. Field staff with general agronomic background may be enough for the above purpose, provided guidance can be given through qualified entomologists available in Universities/research Institutes.

TABLE 4 : Major diseases in the various dryland crops

Crop	Scientific name	Disease	Region
Castor	*Ricinis communis*	Root-wilt	Telangana
Rabi sorghum	*Sorghum bicolor*	Charcoal rot	Deccan *rabi* areas
Redgram	*Cajanus cajan*	Root-wilt & Stem rot	Telangana
Bengalgram	*Cicer arietinum*	Root-wilt	Varanasi, Foot-hills of Shiwaliks etc.
Mustard	*Brassica compestris*	Mildews	Foot-hills of Shiwaliks
Coriander	*Coriandrum sativa*	Mildews	Deccan *rabi* areas
Safflower	*Carthamus tinctorius*	*Alternaria & Rhizoctonia*	Deccan *rabi* areas
Pearl millet	*Pennisetum typhoides*	Ergot	Major areas of pearl millet
Groundnut	*Arachis hypogea*	Bud-necrosis	Andhra Pradesh
Greengram	*Phaseolus aureus*	Buden-crosis	Andhra Pradesh
		Yellow mosaic	Haryana

Disease Control

Many of the diseases have so far been controlled through the genetic approach. The control of downy mildew in pearl millet and grain weathering in *kharif* sorghum are the well known examples. However, a number of diseases still continue to be the potential threat to the transfer of improved technology. Some of the examples are illustrated in Table 4.

There is a need to concentrate the efforts towards a systematic screening of new genotypes in the sick-plots. Many a time, the sick-plots are easily found in the farmers' fields which can be utilized at least for a qualitative characterization of the genetic material.

In situations, where resistant genotypes are not available, efforts should be made to identify cultural methods to avoid the problem. The following examples would illustrate the point :

(a) The root-wilt in castor is found to be a soil problem. It is found to be severe only in these fields where high quantity of organic matter is applied or where waterlogging occurs, Till we achieve. genetic resistance, the available genotypes may be avoided in the above situations. In Hyderadad region, the problem of bud-necrosis in groundnut has been found to be highly related to the date of sowing[6]. This seems to be due to the fluctuations in the population of natural vector.

TABLE 5 : Effecf of different dates of sowing on the intensity of bud-necrosis in groundnut at Hyderabad

Date of sowing	Bud-necorsis (%)
Mid June	22
Mid July	58
Mid August	42
Mid September	40
Mid October	14
Mid November	44
Mid December	54
Mid January	17

Source : ICRISAT Annual report—1977

The bud-necrosis in greengram in Medak district is found to be negligible in situations where early sowing is done and where fertilizer is properly applied (Table 5).

(b) Similarly, the problem of *Rhizoctonia* in safflower can be avoided through delay in sowing whereas the problem of ergot can be avoided through early sowing.

The above experiences clearly bring out that an integrated approach is not only cheaper but become inevitable in selected situations. □

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BIOENERGETICS OF SUGARCANE IN KONKAN

B. P. PATIL*

THE energy crisis and ever increasing prices of energy materials, as the demand is on increase, created global concern for the exploitation of solar energy for human welfare. This is, by far, the under-utilised potential sources of renewable energy. Unlike the many physical means developed to utilize the solar energy on large scale, the use of biological phenomenon (photosynthesis) by growing plants of high biochemical efficiency is the earliest known means of utilising sun's energy on large scale. The harvested produce of crops is the sun's trapped energy stored in bio-chemical compounds. On global basis the total dry matter produced by photosynthesis each year is a staggering 116 billion tonnes which is equivalent to six times the world's annual consumption of oil. But only a small fraction i.e. 0.8% of dry matter is produced on crop land (FAO, 1981).

Sun—the origin of all forms of energy

The incident solar energy on the earth surface is estimated to 460-470 cal/cm^2/day of which 45% is utilizable. But, only 2.5% is utilized by the vegetative cover of the earth. A critical analysis of global biochemical and physical phenomena provides an understanding that all energies have their direct or indirect origin in sun's past or present activities or radiation. This has been the potential source of energy for the world since ages and will remain inexhausted for endless future too.

Sugarcane—efficient solar harvester

Utilization of the solar energy by converting it physically or electrically needs sophisticated equipments and involves high cost. But, the biological machinery by exploiting the plants of high photosynthetic efficiency can be an efficient and easy means of trapping sun's energy for utilization by human. Plants (green) are the only living organisms endowed with the properties to entrap solar energy in chemical compounds. In this context sugarcane (a C-4 plant) provides the best and most efficient crop

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for harnessing solar energy in easily available form. This crop by virtue of its growth habit develops an extensive green foliage, which is about seven times the land surface provided for the crop thus intercepting most of the solar radiation almost throughout its growth period. Naturally, it accumulates large biomass most of which is in the form of sugars

Production of liquid fuel-mineral oil substitue

Now-a-days liquid fuels (ethanol) of plant origin are produced from different biologically efficient crop plants like maize, sugarbeet, fodder beets, sweet sorghum and sugarcane by fermentation of carbohydrates. The efforts have now been intensified further to develop more efficient bio-fuels for substituting mineral oils, the hydro-carbons, presently in wide use. Corn, sweet sorghum fodder beet and sugarbeet containing 55.4%, 10.3%, 9.5%, 14.1% carbohydrates are reported to yield 1523, 1583, 2158 and 2060 gallons/ha of potential alcohol, respectively[1]. Potential alcohol production is estimated to be 1 gallon/14 lbs of fermentable carbohydrates Sugarcane is also among potential alcohol[2] (3300 to 4800 lit/ha) producing crops by virtue of its high total sugar content (16 to 18%) and high yield (over 150 t/ha). Presently sucrose being the main production for human consumption in India, the mollases are used for production of alcohol and other byproducts. But in future sugarcane will be one of the foremost crops for producing bio-fuels in order to lessen the dependence on mineral oils.

TABLE 1 : Millable cane yield and bio-energy production by sugarcane varieties

Varieties	Millable[c] cane yield (t/ha)	C.C.S.[d] (t/ha)	Energy CCS (10^6kg Cal)[e]	Estimated cane tops[f] (t/ha)	Energy tops[g] (10^6 kg Cal)	Estimated bagasse[h] (t/ha)	Energy bagasse[i] (10^6 kg Cal)	Total energy (10^6 kg Cal/ha)	Energy harvest index* (EHI)	Energy ratio (ER)** (Fluck, 1979)[3]
Co. 1163	127.2 ab	14.5	57.2(32.4)	12.7	31.8(18.0)	41.9	87.5(49.6)	176.5(100.0)	0.3	19
Co. 740	120.4 ab	17.5	68.9(37.9)	12.1	30.0(16.5)	39.7	82.9(45.6)	181.6(100.0)	0.4	23
Co. 419	120.9 ab	16.1	63.2(35.8)	12.1	30.2(17.1)	39.9	83.3(47.1)	176.7(100.0)	0.4	21
Co.62175	175.3 c	21.8	85.8(34.3)	17.5	43.8(17.5)	57.8	120.7(48.2)	250.3(100.0)	0.3	28
Co. 975	161.7 bc	23.8	93.7(38.2)	16.2	40.4(16.5)	53.4	111.3(45.4)	245.4(100.0)	0.4	31
Co. 1287	164.2 c	18.3	71.9(31.8)	16.4	41.0(18.2)	54.2	113.1(50.0)	225.9(100.0)	0.3	24
Co. 1340	148.8 abc	18.7	73.4(34.5)	14.9	37.2(17.4)	49.1	102.4(48.1)	212.9(100.0)	0.4	24
Co. 6304	149.4 abc	19.6	77.0(35.5)	14.9	37.3(17.2)	49.3	102.8(47.4)	217.1(100.0)	0.4	26
MS.68/31	111.7 a	14.7	57.9(35.6)	11.2	27.9(17.2)	36.9	76.9(47.3)	162.7(100.0)	0.4	19
MS.68/47	161.1 bc	22.3	87.8(36.8)	16.1	40.2(16.8)	53.2	110.9(46.4)	238.9(100.0)	0.4	29

Figures in parentheses are percentage of total energy

[c] Figures following same letter are N.S.

[d] Commercial cane sugar

[e] 1 t sugar equivalent to 16492.9 MJ
1 MJ = 238.7 kg Cal

[f] 1% of sugarcane yield

[g] 1 t tops = 10465 MJ

[h] 33% of sugarcane yield

[i] 1 t bagasse = 8740 MJ

$$^{**}\text{ER} = \frac{\text{Output of sugar energy}}{\text{Input of energy in NPK}}$$

1 kg N = 77.5 MJ
1 kg P = 14.02 MJ
1 kg K = 9.69 MJ

$$^{*}\text{EHI} = \frac{\text{Energy sugars}}{\text{Energy sugar} + \text{Energy bagasse} + \text{Energy tops}}$$

Yield and biological energy production by sugarcane in Konkan

The Konkan region of Maharashtra is a humid tropic with heavy rainfall during monsoon and clear bright sunshine from October to to May. Sugarcane, which prefers tropical humid climate, grows well in Konkan under irrigation like most humid regions of the world where it is giving high yields. In order to study the performance of different improved varieties in laterite soils of Konkan in terms of yield and bio-energy production a varietal trial was conducted at the Agricultural College Farm Dapoli in 1975-76. The crop was planted in second week of January at 90 cm in furrows with 3 budded 30,000 set/ha pretreated in agallol solution of 50 gm in 100 litres of water. Recommended dose of fertilizers (140 kg N + 125 kg P_2O_5 + 125 kg K_2O) was applied. Nitrogen was applied in four splits as 10, 40, 10 and 40%, respectively at planting with whole P and

K, 6 to 8 weeks after planting, 12 to 14 weeks after planting and 16 to 18 weeks after planting or at earthing up. About 15 irrigations were given to the crop. The crop was harvested in the second week of January after testing the brix between 18 to 21% by refractometer. The data on millable cane yield, commercial cane sugar yield (CCS), estimated bagasse and green top yields and contribution of these to total energy production has been presented in Table 1.

The data in Table 1 reveals that the variety Co. 62175 and Co. 1287 gave significantly higher yield than Co. 1163, Co. 740, Co. 419, MS 68/31 but their yield did not differ significantly than Co. 975, MS 68/47, Co. 1340 and Co. 6304.

In case of CCS t/ha the similar trend was observed in high yielding varieties. But the varieties Co. 740, MS 68/31 inspite of their low yields of millable canes yielded appreciable amounts of CCS in comparison to Co. 1163 and Co. 419.

The data on energy production through commercial cane sugar estimated cane top yields and estimated bagasse yield indicated that about 35% of energy comes from commercial cane sugar whereas about 17% comes from green tops and about 48% from bagasse.

The total energy production in kg Cal/ha is strongly influenced by CCS on one hand and by the millable cane yield on the other. The cane yield of Co. 740 and Co. 419 had a difference of hardly one tonne/ha but Co. 740 gave about 5×10^6 kg Cal/ha/yr higher yield of energy than later. Similarly, the variety Co. 1163 gave about 7 t/ha/yr higher yield of millable canes than Co. 740, while it gave about 5×10^6 kg Cal/ha/yr less energy production due to low content of CCS. Same observation can be made with Co. 1287 as against Co. 975.

On an average, a twelve month crop of sugarcane from January to December produced about 200×10^6 kg Cal/ha/yr in Konkan region of Maharashtra which comes to about 0.55×10^6 kg Cal/ha/day. It is about 1.17% of the incident solar energy on the surface of the earth.

Thus, increasing demand for commercial energy calls for giving utmost consideration for efficient energy production through photosynthesis. Use of this energy as mineral oil substitute will induce farmers to shift their land use at least partly for efficient energy producing crops like sugarcane in near future.

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SELF-DELIVERANCE OR DIGNIFIED SUICIDE

SHASHIBHUSHAN RATH*

Analyses the psychosomatic roots of the instinct called suicide and emphasises that in case of dying patients suicide is not a crime but a relief from the angst, pain and psychological stresses of an individual who not only is a patient but a member of his own family, a parent and a member of the society. Suicide in such cases is never a form of self-condemnation as it usually is but a dignified one, a self-deliverance where the patient voluntarily exits himself from the sick-self nevertheless with significant socio-economical impact.

A hundred years back in a magazine like the Nature a news item revealed that scorpions had a suicidal tendency. We know how the scorpion, if surrounded by a circle of fire, runs the sting into its own head and so expires. Mr. Allen Thomson after conducting an observation at Lucca reported that the scorpion when kept in a glass jar with a bright lamp focussed on it, it loses its head with excitement and then brings the curved sting down upon itself and pierces forcibly. In a moment its sorrows are over and its excitement amounting to despair ceases to vex it. It is in fact, odd to note that such a suicidal mania should be hereditary in scorpions because the dead ones cannot have reported to the survivors that the experiment is successful, while suicide is far from complying with the Darwinian conditions, and favouring the persistence of the species.

Recently too, it was reported (courtesy UPI) that in Tokyo about 150 dolphins hurled themselves ashore in Southern Japan and many died despite efforts to push them back to sea. An official at the Children's World Marine Park said the 2-3 meter long mammals were lying exhausted and were dying on the beach at Aoshima, in Miyazaki province, 965 km south of Tokyo. Fishermen and residents laboured to shove the dolphins out to sea but they returned as if determined to die.

Suicide and Self

Most of the individuals undergo a suicidogenic period sometime or other in their lives, which in fact, is a characteristic of young adult life. The reasons for these gestures of hollow despair are not adequate enough to explain the cause of suicide. It is also observed that the state of mind is a mixed one—the consequential action and the inherent negation. For example, the American teenager driving down the highway at 90 miles per hour is not necessarily going anywhere ; here driving down is the consequential action and apparently going nowhere is inherent negation.

Alienation is deep-rooted in our existence. It might sound simple but quoting R.D. Laing, "We are bemused and crazed creatures, strangers to our true selves, to one another, and to the spiritual and material world—mad even from an ideal stand point we can glimpse but not adopt". It is the realisation that we are potential but are in an alienated state we become outrageously violent, sometimes inwardly and sometimes outwardly.

We cannot understand thoroughly the mental condition at which a person attempts suicide. However, one of the explanations given by neo-psychoanalysts is : "I see you, and you see me. I experience you and you experience me. I see your behaviour. But I do not and never have and never will see your experience of me. Just as you cannot 'see' my experience of you. My experience of you is not 'inside' me. It is simply you as I experience you. And I do not experience you as 'inside' me."

Suicidal tendency is not a state of insanity because sanity today appears to rest very largely on a capacity to adapt to the external world, the interpersonal world and the realm of human collectiveness. Due to the estrangement of the outer world from the inner, any direct awareness of the inner world leads to grave risks.

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We have had accounts of man as animals, man as machines, man as biochemical complexes with certain ways of their own, but there remains the greatest difficulty in achieving a human understanding of man in human terms. That is precisely the reason for not finding any intelligibility in the suicidal behaviour of patients suffering from terminating diseases. In other words, we cannot find any intelligibility in behaviour if we see it as an inessential phase in an essentially inhuman process. Scope should be given to man to realise that though divided into several he is capable of being one.

Doubt and Social System

The rate and distribution of suicide is a property of the system : that there is something about the society, the region or the group that generates its characteristic suicide rate. That is, individual's doubt about the value system of his fellow men, himself, the existing social and cultural systems makes him exasperating for nothing and in turn affects the rate of suicide. Quoting Durkheim : "what is the end of suffering above all. The problem does not exist for the believer firm in his faith or the man strongly bound by the ties of domestic or political society. But more the believer doubts more does he become a mystery to himself, unable to escape the exasperating and agonising question : to what purpose ? No proof is needed that in such a state of confusion the least cause of discouragement may easily give birth to desperate resolutions. If life is not worth the trouble of being lived, everything becomes a pretext to rid ourselves of it".

In spite of the limitations of his sociological theory, suicide, for Durkheim was the mark of civilisation in crisis, of a society which rejects certain of its members who have not managed to integrate themselves into their socio-cultural surroundings. In his treatise on suicide, Durkheim observed that suicide increased not only in times of depression but also in times of rapidly increasing prosperity. He called it 'Suicide anomique'. The disjunction between goals and means, and the consequent strain, leads to a weakening of men's commitment to the goals. that is, to a state of anomie. Robert K. Merton spells out the logically possible ways in which they can adapt to this disjunction : they may either accept or reject the goals ; they may either accept or reject the means.

Suicide is a reaction of the outcast. It is a sort of safety valve or emergency exit that prevents the excessive accumulation of discontentment, frustration and unsatisfied wants. Quite often failure in performing one's role in the social set-up also leads to suicide. Telling things like : "I am such and such a sort of person. I invite you to deal with me on this basis so that you may expect certain things from me" become the root cause of disintegration of personality unless validated by meeting the cultural criteria of the role. Confirmation of our conception about ourselves acts as a check against the emergency exit, which we call suicide. In a sense, we ourselves are responsible for the individual's suicidal tendency. Laing in the Birds of Paradise has very rightly said : "We are all murderers and prostitutes—no matter to what culture, class, nation or society one belongs to, no matter how normal, moral or mature one takes oneself to be".

Whys and Hows of Self-deliverance

The desire to commit self-deliverance can originate from an endless array of circumstances like mental illness, inability to adjust with day-to-day transactions, and can also be a simple desire of an old man to die with dignity as a positive measure by putting an end to the state of unhappy dependancy on the members of a disinterested society that glorifies youth. Jains, even today, observe a suicidal technique known as 'Santharo'—in which death is slow and is caused through starvation.

Euthanasia or as is commonly known, mercy-killing, is derived from Greek meaning a good or happy death referring to the inducement of death by putting the incurable or terminally ill patient to eternal sleep, obviously at their own request. However, there arises a related question : whether a person can be granted a legal sanction to end his life by the other, not because of his debility but because he likes to truncate his life after a full and active living prior to his becoming a burden to his family or society. Such a sanction as a remedy for unbearable pain has been given by Aristotle in his book Politics and also by Plato in the Republic.

Euthanasia is usually understood as mercy-killing by 'the other' basing on the request of the terminally ill patient. It is a paradox in itself from the madical point of view because it contradicts the Hippocratic Oath. The oath is the embodiment of the duties, obligations and ethics of the physicians which assures to relieve suffering, protect and pro-t long life. When the patient is in the mos unbearable, painful stages of a fatal disease like cancer, to prolong life violets the assurance to relieve pain, and again, to relieve pain by killing violets the promise to prolong and protect life. Under such ethical paradox, although no religion or law sanctions suicide, euthanasia by 'oneself' or self-deliverance should not be a crime nor should it be unethical.

Dr. Charlotte Gilmann, herself an American physician, while dying of cancer penned the lines : "when all usefulness is assured of an imminent and unavoidable death, it is the simplest of the human rights to choose a quick and easy death in place of a slow and horrible one. The time is approaching when we shall consider it abhorrent to allow a human being to lie in prolonged agony. For this reason and conviction I have preferred chloroform to cancer".

In this context I remember Kant, for whom the 'other self' is not another Kind of object—for the whole concept of 'objectness' is foreign to the meaning of the 'self'. The 'other self' therefore, is not something to be 'known' but a 'person' towards whom we must act responsibly. A few cases are outlined below :

James Haig's age is 24. He is determined not to live out his natural life because he is paralysed from neck downwards. He says, "I believe there is an afterlife but I do not know if it will be any better than this one". He has attempted at suicide twice but has failed. Because of his almost total disability the first attempt was well organised with an assistant but at the last moment the assistant backed out for the fear of penalty (sentence for fourteen years) imposed on persons aiding suicide. In the second attempt he tried to drive his electrically operated wheel-chair into the river Thames but a few feet ahead the chair toppled over. However, he has confessed before the Observer that his wish to die still remains strong. Above all these, he has told his wife to start a separate life so that she is not marked by the stigma of suicide.

Second case is that of a leading tumour specialist who treats two hundred tumour patients a year, states that he would take his own life if he himself was dying of a particularly painful cancer, because he doesn't trust his colleagues to be able to supress the pain. It indicates that in such type of special context there is nothing wrong at all taking one's own life.

Thus suicide can be a powerful method of self-deliverance especially for patients who are terminally ill. In the recent past Exit, a not so well-known British group had its membership shooting as high as 9,000. The reason being the publication of a ten thousand word booklet titled 'A Guide to Self-deliverance'. But soon after its publication it was banned in the UK. Recently however, a number of sister societies have come up in the States viz. Hemlock Society : Concern for Dying, Society for Right to Die etc. Hemlock Society plans to go ahead with the publication of the pamphlet inspite of the fear of prosecution because its director Derek Humphry is of the opinion that thousands of people want this information and such a publication will create a climate of opinion that will tolerate the right of the terminally ill to end their own lives.

There is nothing wrong in exiting oneself.

Humphry first published the title "Jean's Way" in 1978 giving an account of how he helped his wife, a bone cancer victim to die on her own terms and not those of the disease that ravaged her body. Nearly a thousand letters and telephone calls from the dying and their relatives followed, all of them wanting to know from Humphry how they could end lives in extremis or where such data could be obtained. Assuring himself that a particular patient was terminal and not suffering from emotional problems he sent out photocopies of the list of lethal doses of commonly used drugs.

Administration of lethal drugs like hexobarbitone or thiopentone by injection has a sedative effect and has also been described as pleasant, romantic and lovely. While commenting on the mode of Execution the Royal Commission says : "in about 20 or 30 seconds, perhaps before the dose was completed the drug would reach the brain. There would be no danger of failure if a large enough dose were given, and the prisoner would feel nothing after the prick of the needle".

It should be the fundamental right of everyman to die a dignified death. Minoo Masani has set up an Indian branch of the Society for the Right to Die with Dignity (SFRDD). There are already 27 branches all over the world with many eminent writers, doctors, scientists, lawyers and industrialists as its members.

In Steppenwolf, Herman Hesse has put in a succint way : "Finally, when he was about 47 years old, Harry had a happy, not entirely humourless thought. He set the date of his fiftieth birthday as the day on which he would allow himself to commit suicide. On that day, he agreed with himself that he would be free to use or not to use that emergency exit......". Let us die the Cleopatra's death which is nothing but dignified suicide. Death, one day, will no more remain a gnome, a dread but instead will be a sort of relief, an exit, a deliverance. ☐

NOTES & NEWS

The National Symposium on Pigment Metabolism in relation to Vitiligo

Under the auspices of Indian Chemical Society and other cosponsors like IADVL (W.B. Branch and Central Organisations), Bose Institute, AIIMS, ICMR, DST, New Delhi, a National Symposium on Pigment Metabolism in relation to Vitiligo was held at Bose Institute, Calcutta on September 22-23, 1984.

The symposium was inaugurated by Prof. B. K. Bachhawat, Director, IICB, Calcutta and presided over by Dr. B. N. Banerjee, an eminent Dermatologist of India. The Convener of the symposium Prof. D. P. Chakraborty, Chairman Department of Chemistry, Bose Institute called upon the Doctors and Scientists to take up a cordinated programme of this subject of interdisciplinary scientific investigation to fight the national malady which in consideration of its incidence was next to tuberculosis and leprosy in India. Speakers from different parts of India and Prof. A. B. Lerner of the school of Medicine, Yale University, U.S.A., spoke in the meeting. Prof. Lerner put forward that abnormal melanoma cells were responsible for this malady. Neurogenic factors may be contributory to this malady. Dr. B. N. Behl, Director Skin Institute, New Delhi, suggested that different etilogical factors are presumably at play in different individuals. Hence, the treatment has to be individualised. Prof. S. K. Panja in his talk suggested that histamine is a toxic mediator for the pathogenesis of Vitiligo. Prof. R. K. Panja presented his data on the role of hypothalamus in Vitiligo. Dr. A. K. Dutta presented a review on the basis of his data on clinical observation that the cases should be classified into different groups. Prof. D. P.

Chakraborty in his lecture spoke on the introduction of pure psoralen as a chemotheraputic agent in 1957 by himself and Dr. A. K. Roychowdhury and its efficacy as the best of the group of drugs used in Vitiligo. The lecture of Prof. J. N. Chatterjee on the synthesis of compounds related to psoralen was presented by Dr. D. Mal. Prof A. Ramaiah of AIIMS spoke on the modification of the solubilized enzyme tyrosinase from melanosormal fraction on exposure to pH 5.0 on citrate. Prof. D. P. Mukherjee spoke on the anthropological genetical aspects of the disease. The frequency of the disease in different strata of the society their geographical location in India were also mentioned. The physiological aspects of Vitiligo patients were discussed by several workers.

A resolution requesting the publishers of various dictionaries to state correct meaning of Vitiligo, as a disease of the pigmentory disorder instead of a variety of leprosy was passed by the general meeting of the Symposium. ☐

D. P. Chakraborty

Highlights of Research and Development under Department of Atomic Energy during 1983-84

India's programme for the utilisation of atomic energy for its economical development made rapid strides during 1983-84. The power reactor (unit-I) at Kalpakkam designed, engineered and built entirely by Indian Scientists and engineers, attained criticality on July 2, 1983 and was synchronised to the grid by the Prime Minister on July 23, 1983. India is thus one of the few countries in the World capable of designing, building, fuelling and operating power reactors entirely on its own. The power reactor (unit II) at Rawatbhata achieved record performance with an operating factor of 85.33 per cent during the year. In the latter half of the year the heavy water plants at Baroda and Tuticorin have been producing their targetted quantities.

R & D at BARC : Research and development activities at the Bhabha Atomic Research Centre (BARC) moved forward contributing to the building up of the nuclear power programme of the country with significant spinoffs in the fields of space, defence, industry, agriculture and medicine. Founded in 1957 at the Atomic Energy Establishment at Trombay, BARC's activities cover diverse fields such as physics, chemistry, engineering, metallurgy, reprocessing, fuel fabrication, waste management, radio-isotopes, electronics instrumentation, lasers, biology, agriculture, food technology, radiation medicine etc.

Research Reactors : In the field of research reactors expertise from design to operation stage has been fully developed. The country's MW swimming pool reactor APSARA built in 1956, countinues to be used for isotope production and physics experiments.

The 40 MW CIRUS reactor, operating since 1960 has provided valuable production, experimentation and training facilities. Commissioned in 1961, ZERLINA—the zero energy reactor, was decommissioned in 1983 after rendering useful service in studying new reactor concepts and components.

The zero energy fast reactor assembly PURNIMA was built in1972 and is presently under modification to operate using uranium (233) fuel (PURNIMA II). Another mini-pool reactor also containing uranium (233) as fuel, is under construction at Kalpakkam, for neutron radiography experiments.

A new high flux indigenous reactor at Trombay, called DHRUVA will be commissioned in 1984. DHRUVA is a natural uranium heavy water moderated reactor of 100 MW thermal power and incorporates several new features including a new fuel concept.

Nuclear Fuel Research & Development: Since the inception of atomic energy programme, R & D efforts have been directed towards achieving selfreliance in meeting the fuel needs of the reactors. The Uranium Metal Plant at Trombay, which produced its first ingot of fuel in January 1959 was partially recommissioned during the year.

Fuel elements and subassemblies for CIRUS reactor and metallic uranium fuel clusters and other components for DHRUVA reactor were fabricated. Design and fabrication work for the new plutonium rich carbide fuel was undertaken at BARC. Development work on uranium (233) based fuel fabrication as well as R & D work in thorium utilisation was carried out.

Reactor Research Centre : The Reactor Research Centre was established in 1971 at Kalpakkam, Tamil Nadu, to carry out development of sophisticated breeder technology. The Fast Breeder Test Reactor is expected to be commissioned towards the end of 1984. This is a 40 MW thermal sodium cooled reactor. It will generate about 15 MW of electrical power, using mixed carbide fuel developed and manufactured at Trombay. Laboratories have been commissioned for handling active materials, reprocessing and separation of plutonium, sodium, materials development, reactor engineering, electronics and instrumentation, and safety research.

Work on the design of 500 MWe Prototype Fast Breeder Reactor commenced and preliminary reports prepared.

Centre for Advanced Technology : Work on setting up the Centre for Advanced Technology at Indore commenced on February 19, 1984 with the unveiling of a plaque by the President.

The Centre will work on a variety of advanced and frontier technologies which have been engaging the attention of BARC, such as accelerators, lasers and fusion. The Centre will evolve designs for large high enery acceleretors, laser systems for fusion investigations and advanced MHD systems etc.

Variable Energy Cyclotron Centre (VECC) : VEC, set up at Calcutta by BARC, is emerging as a national research facility with the major users being scientists from universities througout the country. An additional beam transport channel and radiofrequency system were commissioned this year.

Magnetohydrodynamics (MHD) Project : BARC, in collaboration with BHEL, has been engaged on the development of an experimental 5 MW MHD plant at Tiruchirapalli, Tamil Nadu, the construction work of which was largely completed. The plant is expected to be in operation in 1984.

Support to Basic Research in Nuclear Sciences : In addition to the High Altitude Research Laboratory at Gulmarg, National Research Laboratory at Srinagar and Seismology Station at Gauribidanur, institutions aided by DAE like the Tata Institue of Fundamental Research and the Saha Institute to Nuclear Physics, Calcutta are engaged in research geared to achieve self-reliant base in nuclear science and technology. DAE also supported research and development work in various disciplines related to atomic energy in Indian universities and other academic institutions by giving project-linked financial assistance and fellowships. The Department also provided grants to institutions for the development of mathematics. During the year Rs. 1.3 crores were allocated by DAE as grants-in-aid to universities and institutions. □

Nuclear India

Active manganese dioxide

Manganese dioxide is a good conductor of electricity and is largely used in the manufacture of dry cells. Since production in the country is not adequate, active manganese dioxide has to be imported every year in considerable quantity.

Though pyrolusite is the common source of manganese compounds, the difficulty is that manganese salts when heated with oxidising agents such as nitric acid, potassium permanganate, nitrosyl chloride as well as ammonia plus bromine does not yield pure manganese dioxide. Although pure manganase dioxide can be produced by heating manganese nitrate to a temperature of about 200 degree centigrade, the method is not sufficient to meet commercially demands of active manganese dioxide. Again, though active manganese dioxide can be obtained by electrolytic method, its feasibility, however, lies where electricity is cheap. But this process does not seem to be appropriate at present since production of active manganese dioxide requires a large amount of power varying from 6000 to 7000 KWh for each tonne of the material.

Researchers of the Regional Research Laboratory, Bhubaneswar revealed that for the purpose of obtaining active manganese dioxide, a low-grade manganese ore even can be employed. The process consists in treating ground ore with ferrous sulphate when the corresponding sulphate is formed. Ammonium sulphate can also be used. These sulphates are then converted into the carbonates or the hydroxides. Both on heating produce manganese dioxide. This operation is called calcination and the sulphate production the sulphatisation. One of the advantages of using the process is that active manganese dioxide can be produced from any kind of ore available indigenously □

P. C. Bhattacharyya

Research into mine safety

Greater safety and more efficiency in the coal industry is the aim of Australian Government-funded research into methane-gas drainage from mines.

Gas drainage is a technique by which gas is extracted from the coal seam and taken to the surface. This reduces the risk of outbursts of gas and coal at the workface—the possibility of explosions and fires. It markedly reduces the problems of ventilation and improves productivity.

The project has proved extremely effective in reducing the methane concentration in the mine working area and the risk of outbursts. As a result, more coal can be won. Recovery has been increased and operating costs have been reduced. Subject to market availability the mine, West Cliff Colliery in New South Wales, is now able to mine in a year up to one million tonnes more of the export-coking coal A pilot plant has been installed to use the vented methane to generate electicity. □

Australian Information Service

Garden-Waste shredder

Gardeners will be able to convert garden rubbish into soil-enriching mulch by using a cheap portable device invented by a South Australian lawnmower serviceman, Kenneth Schuppan. The attachment fits under conventional rotary mowers and uses the blades to shred organic matter into garden-ready mulch. An additional power unit is not required, which gives the device a significant cost advantage over other shredding systems. □

Australian Information Service

New-style desalination system

Australian engineers have developed a continuous magnetic ion-exchange system for desalting large amounts of brackish water by using specially treated resins in a process sought unsuccessfully in other parts of the world for about 30 years.

The demonstration plant, with a production capacity of one million L of potable water per day, is capable of desalting enough brackish water to supply a town of up to 10,000 people with sufficient cooking, drinking and washing water for a year.

The system—Sirotherm—is a joint project between Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), Perth's Metropolitan Water Authority (MWA) and private industry. The system uses magnetised ion-exchange resins, specially developed by the CSIRO and ICI, to lift the salt from brackish water and a hot-water process removes the salt.

A major advantage of the process over other desalination system is its capability for continuous regeneration. The plant never has to be shut down and this gives it a great merit in operating simplicity and improved operating economics. Another benefit is that it only uses cheap low-grade heat in its operation and if necessary it could use solar heat for some stages. □

Australian Information Service

BOOK REVIEWS

The Sulbasutras—S. N. Sen and A. K. Bag. Publisher : Indian National Science Academy, New Delhi, 1983. Pp. 293. Price Rs. 85/-.

Different sciences have flourished at different times in different societies. They have been directly related to the habits, modes of thinking and the social organisations of those communities. This itself is an interesting study—the logical connection between the habits and rituals and the technologies evolving out of those practices, between the culture and the specialised branch of knowledge which evolved out of that culture.

History of science has recently emerged as a separate academic discipline. This calls for the active co-operation of scientists as well as historians so that the intellectual activity which began since man first came to grips with nature can be studied from a variety of angles.

It is very gratifying to see that the Indian National Science Academy has taken upon itself the task of initiating researches on the sources of history—to provide the ready raw material so to speak for the serious scholars and historians. Until very recently the educated Indian was conditioned to believe that all light came from the west and science had its sacred origin in Greece. It is time the younger generation were given a more pervasive and neutral view of history.

The widely accepted belief that geometry had its crude origin as a set of practical rules for mensuration and land-surveying in ancient Egypt and Babylon is now being questioned. Scholars are now of opinion that the knowledge of geometry needed for the purpose of land measurement was only an approximate knowledge. The theory that exact geometry arose out of land surveying in Egypt or Babylon is not supported by evidence. On the other hand geometry in the sense of an exact science developed from the techniques of the masons, architects and engineers. This clearly points out to the evidence we have from Indian cultural history and in a different technological context, namely that of brick-making and brick-laying.

The Pythagorus theorem was also known to ancient Indians, who came upon it by way of constructing square and rectangular shaped alters. This geometry has come down to us as codified in a class of literature called the SULBA SUTRAS.

Thanks to the painstaking work done by S. N. Sen and A. K. Bag—This volume provide us with a glimpse, showing us how the development of geometry and algebra was inherent in our scriptural tradition. The Sulbasutras are manuals for the construction of altars for fire-sacrifice. Of the various composers of these formulas or sutras they have selected four—Bandhayana, Apastamba, Katyayana and Manava. The original sanskrit texts are given in Roman script along with their English translation. In the third section of the book we have the commentaries given by Sen and Bag.

In the commentary the units of measurement used by the sutrakars are discussed and explained not in the order in which they appear, but edited according to importance and avoiding overlapping. The mathematical significance of the text can be well understood from the way methods of constructing squares and transformation of geometric figures, heights, distances positions etc. are mentioned, even placement of bricks for each layer is to be done in accordance with special rules. Bandhayana proposes two types for making a fire—altar in the form of a falcon with curved wings and extended tail. Apastamba gives the formula for two variations of the same figure.

There is a lot of controversy regarding the exact time and place of the writing of these sutras, but there is general agreement that the sutras were composed between 800 to 500 B.C. The involved and irregular forms used by the first two put them very definitely before Panini. The evidences put forward by various scholars have been discussed in the introduction. There is an equally valuable index of technical terms used in the original text. Sen and Bag deserve our thanks, not only for the stupendous labour involved in the compilation, but also for their cool, rational analysis, particularly because the whole thing is submerged in religious rituals. The structures were supposed to have special significance—part magical part relegious, for example, in order to ensure entry into heaven, the altar had to be made in the shape of a falcon. For the destruction of one's enemy, the altar was to be built in the shape of a chariot-wheel. The shape of the altar was connected with specific desires, or wishes to be fulfilled. But along with this kind of faith flows reason—how exactly to construct the altars and a thorough knowledge of the technology involved. □

Enakshi Chatterjee

Catastrophe theory and applications. Ed. D. K. Sinha. Publisher : South Asian Publishers Pvt. Ltd., Pp. xii + 158. Price Rs. 75/-.

There is, hardly, any branch of science to which the catastrophe theory has not been applied. Unfortunately only a few books are available which simultaneously bring out the basic contents of the catastrophe theory along with examples of their applications to various disciplines. The current publications, which arose out an interdisciplinary seminar conducted in 1979 at Jadavpur University, admirably fulfils the dual purpose of acquainting research workers with the recent trends and developments in catastrophe theory and providing examples of useful applications of the theory in physics, bio-physics, earth sciences, medical sciences and linguistics.

The first six papers of the present volume have been written by Prof. E. C. Zeeman alone or with his colleagues, who, as is well known, is perhaps the most important mathematician who has been responsible from enlarging the scope of Catastrophe theory as a mathematical method discovered by Rene Thom to describe evolution of forms of nature to its present extensions covering large areas of pure and applied mathematics. In the first paper Zeeman has discussed the seven elementary catastrophes, his famous catastrophe machine and application of Catastrophe theory to factors governing aggressive behaviour in animals. In the following articles, applications of catastrophe theory to the stability theory and light caustics have been discussed. In the next paper Zeeman along with Smith and Harrison have analysed some discontinuous processes associated with Baysian decision theory. Zeeman has discussed the applications of Catastrophe theory to the anorexia nervosa and its cure by trance theraphy. In the next paper Prof. Zeeman has given replies to some of the questions raised during the seminar on general theoretical aspects, as well as of their potential fields of applications. In the following paper Prof. C. K. Majumdar has discussed the application of Catastrophe theory to phase transitions and nuclear fission. In his paper, Prof. J. N. Kapur has examined the problem of competition of species from three points of view viz. Lotka-Volterra theory, the theory of games and Thom-Zeeman Catastrophe theory. In an interesting article Dr. A. K. Roy has described how a logics-mathematical theory of languages can be developed. This has been followed by a paper on the language aspects of Catastrophe theory. Biomechanical applications of Catastrophe theory have been discussed by Prof. D. K. Sinha while applications to earth sciences have been discussed by Mitra and Sinha. Bifurcations of time periodic solutions which are important in the investigations on regulatory biochemical networks has been examined by Dr. A. B. Roy using Catastrophe theory, while applications of bifurcation theory in physical and biochemical systems have been considered by Dr. D. Sen. An important feature of the book is an extensive bibliography on Catastrophe theory prepared by Dr. Poston and Stewart.

Apart from a few minor printing errors, the book is almost free from blemishes. The editor and the organisers of the seminar deserve full credit for their valuable contributions in this field. □

A. M. Ghose

SCIENCE CORNER

Articles published in this section are for students and general readers for understanding science in the perspective of its fundamentals. We invite science teachers and scientists for contributing articles to this section. Also we shall appreciate comments from our readers on the articles published in this section.—*Ed.*

ACCELERATORS AND THEIR RECENT APPLICATIONS

S. B. KARMOHAPATRO*

WITH the dawn of the present century, the discovery of radioactivity by Bacquerel and Curie made a revolutionary change in our ideas about matter. To produce artificially radioactive substances from the stable elements, fast projectiles of charged particales were needed. Dirac predicted an antielectron or positron even an antiproton. Since the proton was 1836 times as massive as the electron, the formation of Antiproton required at least 1836 times as much energy as the formation of a positron. We had to wait for the development of accelerators for accelerating subatomic particles to sufficiently high energies.

In 1928 John D cockroff and Earnest Walton developed a machine to accelerate protons 400 thousand electron volt. One electronvolt is equal to the energy developed by an electron accelerated across an electric field with a potential of one electronvolt. With protons accelerated in this machine, they were able to break up the lithium nucleus, and for this work they were awarded the nobel prize for physics in 1951. Next Van de Graff developed an electrostatic generator and could accelerate protons to 8 Mev.

Another method gave birth to the linear accelerator in 1931 in which particles are driven down a tube divided into sections. The driving force is an alternating electric field, it is managed in such a way that as the particles enter each successive section, they get another push. Since the particles speed up as they go along, each section must be suitably longer than the one before, so that the particles will take the same time to get through it and will be in phase with the proper timing of the pushes.

A better idea conceived by E. O. Lawrence was given shape in a cyclotron in which the particles travel round a circular path. A magnet could bend them in such a path. Each time they completed a half circle, they would be given a kick by the alternating field. As the particles speeded up, they would move in wider circles and take the same time for each round trip, since in wider circles their velocities increase. By 1939, laboratory in the University of California had a cyclotron to raise proton energy to 20 Mev. Lawrence, the inventor of the cyclotron was recognised with the nobel prize in physics in the same year.

The acceleration due to cyclotron itself had to stop at about 20 Mev, because at that energy, the particles were travelling so fast that the mass increase with velocity—an effect predicted by Einstein's theory of Relativity—became appreciable. This increase in mass due to high velocity causes the particles to start lagging and falling out of phase with the electrical kicks. The remedy was worked out by Veksler and McMilan by synchronising the alterations of electric field with the increase in mass of the particles. Such modification of cyclotron, called synchro-cyclotron could be built up to raise the energy to 800 Mev.

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Electrons being lighter particles have separate problems for acceleration. To be useful in smashing atoms, the light electrons had to be raised to much higher speed than protons. The cyclotrons could not work for electrons, because at the high velocities needed to make the electrons effective, their increase in mass was too great. In 1940, Kerst designed a transformer device which balanced the increasing mass with an electric field of increasing strength. The electrons were kept in the same circular path instead of spiralling outwards. The instrument was named betatron, after beta particles. They can generate electrons upto 340 Mev.

A slightly different design called Electron Synchrotron was built by Goward and Barnes in 1946. These raise electrons to 1000 Mev, but cannot go beyond, because electrons moving in a circle radiate energy at increasing rates as velocity is increased. Such radiation produced by an accelerating particle is called Bremstrahlung, a german word meaning breaking radiation.

Taking lessons from the betatron and electron synchrotron, physicists working with protons began about 1947 to build proton synchrotrons which like-wise kept particles in a single circular path. This was helpful in saving on weight. When particles move in spiralling paths, a magnet must extend the entire space of the spiral to keep the magnetic force uniform throughout. With the path in one circle, the magnet need be only large enough to cover a narrow area. Because the more massive proton does not lose energy with motion in a circular path rapidly as does the electron, physicists could surpass the 1000 Mev limit with a proton synchrotron. 1000 Mev is 1 Giga-ev. greek ward for gi. Brook-haven National Laboratory, in 1952, completed a proton synchrotron called cosmotron that reached 2 to 3 Gev. Two years later University [illegible]fornia developed a bevatron producing particles 5 to 6 Gev. In 1957 Soviet Union reached 10 Gev with their phasotron.

But by now these machines seem to be pigmies in comparison with accelerators of newer-type called the strong focussing synchrotorn. The limitation on the Bevatron type is that particles in the stream fly off into the walls of the channel in which they travel. The new type counter-acts this tendency by means of alternating magnetisc fields of different shape which keep focussing the particles in a narrow stream. This incidentally further decreased the size of the magnet required for the energy value attained. Where particle energy was increased fifty fold, the weight of the magnet involved was less than doubled.

In the year 1959 the European Committee for Nuclear Research (CERN) a cooperative agency of 12 nations completed in Geneva a strong focussing synchrotron which reached 24 Gev. Brookhaven constructed one reaching 30 Gev and the soviet union completed a similar machine of 70 Gev energy. CERN has been operating a super synchrotron of 270 Gev energy. A few others are completed or are near completion. 2000 Gev Synchrotron under development in the Fermilab requires special mention.

The idea has been welcome of having two accelerators in tandem so that a beam of energetic particles collides head on with another beam moving in the opposite direction. This will quadrupole the energy involved over the collision of one such beam with a stationary object.

Electron-positron collider or proton-antiproton collider synchrotron is a single machine, in which the collision occurs in the same magnet because of the opposite charges of the particles. CERN super-proton synchrotron as an antiproton collider reaches 540 Gev energy. A 50 Gev positron-electron collider is under construction at CERN.

From cosmotron to super synchrotron, the range of the modern synchrotron comprise a marvel in instrumentation. Like the lamp

Aladin, Physicists use these machines for hat they ask for.

With merely the Bevatron, man at last came ithin reach of creating the antiproton. In 1955 hamberlain and Segre bombarded copper ith 6.2 Gev protons for many hours and efinitely detected at least 60 anti-protons. hey received the nobel prize in 1959 for their iscovery.

The discovery established the basis for the existence of antimatter, a new concept in physics, predicted by Dirac long before.

Synchrotrons have helped as meson factories to discover a large number of elementary particles. These particles have changed our conventional concepts about matter and force. Particle physics is now a new subject sometimes called high energy physics, since the exotic particles are achieved through the collision of high energy particles.

Recently attempts are made by physicists to unite the cosmology and particle physics.

It is believed that the origin of the universe is due to an explosion called bigbang. In the moment of such creation all the four forces gravitation, strong nuclear force, weak nuclear force of β-decay, Electromagnetic forces were united together. At a moment, the force of gravitation separated, next the strong force. At the instant of 10^{-13} sec after the bigbang, electromagnetic force and weak force were unitedly • was an electro-weak force not separated from each other. Glashow, Abdus Salam and Wienberg theoretically showed the existence of the electroweak force and predicted the existence of $W^{\pm}$ and Z^{0} particles by the electroweak theory. In 1979 they were awarded nobel prize, when a notable experimenter was heard to remark on learning the news "does this mean they will have to give the prize back if we do not find the Z or W". The question was to remain a hypothetical one. Thanks to the synchrotron which proved the prediction true. In 1983 the super proton synchrotron as proton antiproton collider run at an energy 540 Gev, definitely proved the existence of $W^{\pm}$ centered around 81 Gev and Z^{0} at 93 Gev at the rest mass energy, predicted by the theory. For conducting the experiment Rubbia and Meer have been awarded Nobel prize in physics in 1984 ; Meer was responsible for devising the stochastic cooling method to concentrate the Antiproton beam sufficient for interaction with the protons from the opposite direction to produce detectable $W^{\pm}$ and Z^{0}. The detector systems UA1 and UA2 operated by the scientists of CERN unequivocally produced the said intermediate vector Bosons, the exchange particles of the weak force. The experiment is described to be the most difficult one and to be one of the greatest achievements in science in the present century.

The 2000 Gev machine at Fermilab when completed will provide the highest energy within the reach of the physicists and will unveil many exotic phenomena which are not even imagined with a human mind. □

LETTERS TO THE EDITOR

'Kumar Jal'—a catfish fishing method of Hooghly-Matlah estuary

Fishing methods of Hooghly-Matlah estuary have been described in detail by a number of workers in the past[1-7]. But for a very brief mention regarding fishing with the help of bush[4], no account is available in literature regarding a barrier type of net, locally known as 'Kumar Jal', the principal net for catfish fishing, employed in lower reaches of Hooghly-Matlah estuary (Sunderbans area). This method of fishing was observed in detail by the authors while the senior author was working on biology and fishery of the canine catfish-eel, *Plotosus canius* Hamilton.

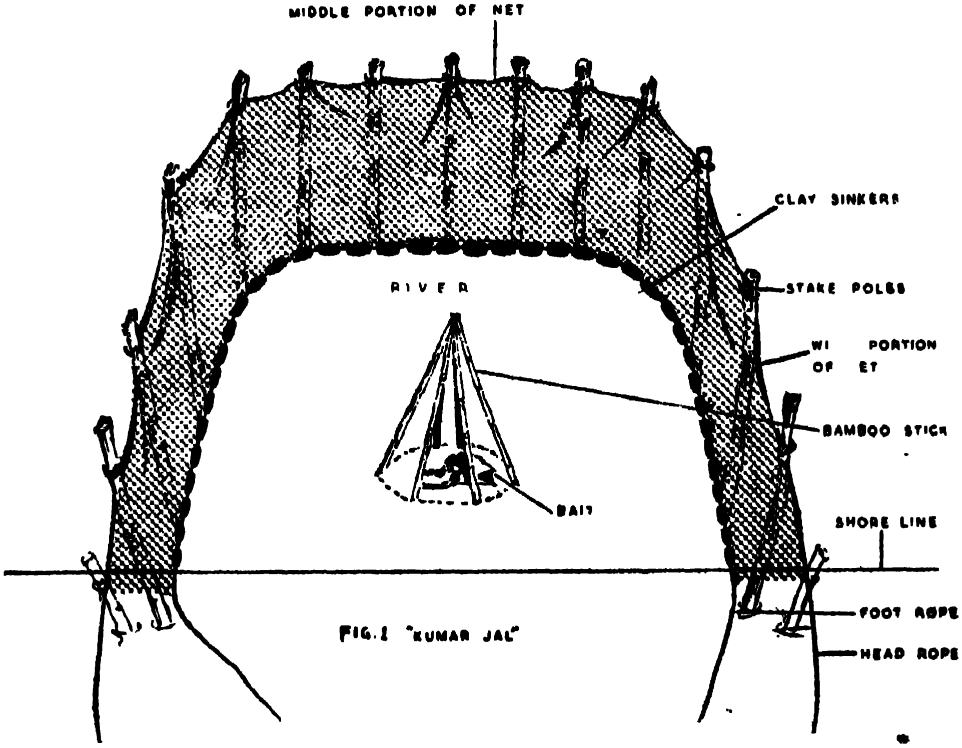

FIG. 1 'KUMAR JAL'

'Kumar Jal' consists of three pieces of nets, one middle piece and two wings, with foot and head ropes (Fig. 1). The mesh-size gradually increases from foot rope end to head rope end and ranges between 6-12 mm. The length of the middle piece varies between 30-36 m, whereas, each wing is 18-21 m in length. The height of the middle piece is 7.5-8 m and the wings about 3.5-6 m. The foot rope is weaved, like garland, with small fire clays which work as sinkers. The entire length of the net is variable, according to the area available for operation and manpower availability.

This net is operated near the bank having low water level. Twelve to fifteen days before actual operation, a bush, comprising of a bundle of split bamboo poles, is placed in a selected place in the river. The split bamboo pieces are tied at the top and their bottom free ends are fixed in the river bed (Fig. 1). Dead goat guts or small dead animals are tied within the framework of the bush to attract carnivorous fishes. When the fishes get accustomed to feed in the bush area in 12-15 day's time, a sizeable area around the bush is encircled with bamboo poles (stake poles) pitched in the river bed at an interval of 3-3.5 m, during the ebb tide period, without disturbing the bush. Now the foot rope of the net is buried in the river bed towards the bush side of these poles in such a way that no gap is left between the foot rope and the river bed. The wings are fixed towards embankment and the middle part towards the deeper water area. As the high tide reaches its peak, the net is fully stretched and the head rope is tied with the top of the stake poles. In this way a semicircle enclosure is made of the net, ensuring that the fishes which have come to feed in the bush area are unable to escape. When the ebb-tide starts, the foot rope is gradually dragged from the wing end towards the shore. The process of dragging is very slow and gentle. The bush is pulled off when the foot rope reaches near it. Ultimately, the foot rope of the middle piece touches the shore and the two wings overlap each other. As such, a bag is formed at the middle portion of the net and all fishes get slowly driven to this bag. At this stage, the head, rope is untied, simultaneously, by a number of fishermen, at all points, and brought to the shore, thus, covering the top of the bag. The captured fishes (mostly different species of *Mystus*, *P. canius* and other estuarine catfishes) are then removed.

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Anti-bacterial and anti-fungal activity of some new bis-(styryl) sulphones

The sulphones are probably best known in therapy and in agriculture[1,2]. The discovery of dapsone, 4, 4′-diaminodiphenyl sulphone, as potential drug against leprosy has revolutionised its whole treatment[3]. The sulphones are well known as fungicidal[4] and anti-leprotic agents[5]. Marked anti-tubercular[6] and anti-bacterial[6,7-9] activities are reported for sulphones. Vinyl sulphones possess the fungicidal[10] and anti-tumour activity[11]. The following new bis-(styryl) sulphones were synthesised and evaluated for their fungicidal and bactericidal activities according to the modified paper disc method of Thornberry[12]. The results are presented in Tables 1 and 2.

$$\mathrm{Ar-CH=CH-SO_2-CH=CH-Ar}$$

Compound Number	Ar
1	3-ClC_6H_4
2	3, 4-$Cl_2C_6H_3$
3	2-FC_6H_4
4	4-FC_6H_4
5	2-$CH_3C_6H_4$
6	3, 4-$(CH_3O)_2C_6H_3$
7	2, 3-$(CH_3O)_2C_6H_3$
8	4-$CH_3O\ C_6H_4$
9	2, 5-$(CH_3O)_2C_6H_3$
10	2-$NO_2C_6H_4$
11	3, 4-(-O-CH_2-O-)C_6H_3
12	3-Pyridyl

TABLE 1 : Anti-fungal activity of twelve sulphones

Compound number	Zone of Inhibition**											
	Helminthosporuim oryzae		*Corynespora cassiicola*		*Aspergillus niger*		*Alternaria solani*		*Phizoctonia solani*		*Pencillum notatum*	
	1000	50	1000	50	1000	50	1000	50	1000	50	1000	50
	ppm		ppm		ppm		ppm		ppm		ppm	
1	+ +	–	+ +	–	+ +	–	+ +	–	+	–	+	–
2	+ +	–	+	–	+	–	+ +	–	–	–	+	–
3	+ + +	–	+ + +	–	+ + +	–	+ + +	–	+ + +	–	+ +	–
4	+ +	–	+ +	–	+ +	–	+ +	–	+ + +	–	+ +	–
5	+ + +	–	+ +	–	+ +	–	+ +	–	+	–	+ +	–
6	+	–	–	–	+ +	–	+	–	–	–	+	–
7	+ + +	–	+ + +	–	+ +	–	+ +	–	+ +	–	+ +	–
8	+ +	–	+	–	+ +	–	+ +	–	+ +	–	+	–
9	+	–	+ +	–	+ + +	–	+ +	–	+ +	–	+ + +	–
10	+	–	+	–	+ +	–	+	–	+	–	+ +	–
11	+	–	–	–	+	–	–	–	+	–	–	–
12	+ + +	+	+ + +	+	+ + +	+	+ + +	+	+ + +	+	+ + +	+
Thiram	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +

** + indicates zone diameter between 6-8 mm, + + indicates zone diameter between 9-14 mm, + + + indicates zone diameter between 15-20 mm, + + + + indicates zone diameter more then 20 mm and – indicates no inhibitory zone.

TABLE 2 : Anti-bacterial activity of twelve sulphones

Compound number	Zone of Inhibition**							
	Rhizobium japonicum		*Bacillus subtilis*		*Xanthomonas oryzae*		*Pseudomonas viticola*	
	1000	50	1000	50	1000	50	1000	50
	ppm		ppm		ppm		ppm	
1	+ +	–	+	–	+ +	–	+ +	–
2	+ + +	–	+ +	–	+ +	–	+ +	–
3	+ + +	–	+ +	–	+	–	+	–
4	+ +	–	+ + +	–	+ + +	–	+ + +	–
5	+ +	–	+ +	–	+	–	+	–
6	+ +	–	+ +	–	–	–	–	–
7	+ +	–	+ +	–	+ +	–	+	–
8	–	–	–	–	+	–	+	–
9	+ +	–	+ +	–	+	–	+	–
10	+	–	+	–	+ +	–	+ +	–
11	+ +	–	+	–	+	–	+ +	–
12	+ + + +	+	+ + +	+	+ + +	+	+ + +	+
Tetracycline	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +	+ + + +	+ +

** + indicates zone diameter between 6-8 mm, + + indicates zone diameter between 9-14 mm, + + + indicates zone diameter between 15-20 mm, + + + indicates zone diameter more than 20 mm and – indicates no inhibitory zone.

The following strains are used for testing the anti-bacterial and anti-fungal activity. *Helminthosporium oryzae*, *Corynespora casiicola*, *Aspergillus niger*, *Alternaria solani*, *Rhizoctonia solani*, *Pencillium notatum*, *Rhizobium japonicum*, *Bacillus subtilis*, *Xanthomonas oryzae* and *Pseudomonas viticola*. The purified compounds were dissolved in ethanol and tried at concentrations of 1000 and 50 ppm. The Whatman filterpaper discs with different compounds were plated asceptically on seed-nutrient-agar plates with different bacteria and fungi. Thiram and Tetracycline were used as standards for the screening of fungicidal and bactericidal activity respectively. The fungi were incubated for 7 days at 28±2°C and bacteria for 72 hr at 37±1°C. At the end of the incubation period, the diameters of the growth inhibition zones were measured.

All the compounds were found to be active. Their activity and mode of action varied depending on the position and substituents in the benzene ring. It is evident from fungicidal screening data that the activity increases when the substituent is in *ortho* position, which may be due to the *ortho* effect. Thus, it may be concluded that the increase of electron density on the benzene nucleus decreases the fungicidal activity. Nitro-substituted compound is less active than halogen-substituted compounds. The compound **12**, bis-2-[(3-pyridyl) vinyl] sulphone is showing maximum activity than the rest of the compounds. With the exception of compound **12** which is showing little activity, all other compounds are inactive at the minimum concentration.

Bactericidal screening data also shows that the *ortho* substituted compounds are more active than the *para* substituted compounds but only with an exception of *p*-fluoro substituted compound. The compound **11**, bis-[3, 4-(methylenedioxy) styryl] sulphone, which is inactive towards fungi, is active towards bacteria, and it shows minimum growth in negative bacteria, whereas it shows moderate growth in positive bacteria. The compound **12**, bis-2-[(3-pyridyl)vinyl] sulphone is having maximum activity at 1000 ppm and shows slight activity at 50 ppm. All other compounds are inactive at 50 ppm. Based on the screening results, it may be stated that when a phenyl ring is replaced by a heterocyclic ring like pyridine the activity increase enormously and it has been proved by the compound **12**, bis-2-[(3-pyridyl) vinyl] sulphone which has got maximum anti-bacterial and anti-fungal activity than the rest of the compounds in the series. The experiments provide some clue for finding out more active compounds in the series.

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Effect of penicillin and its interaction with IAA on the rooting of mungbean cuttings

Work from this laboratory has demonstrated that penicillin can mimic gibberellins in stimulating the synthesis of α-amylase[1,2] and ribonuclease[3] in embryoless rice (*Oryza sativa* L.) endosperm. Penicillin can also be as active as cytokinins in enhancing chloroplast pigment formation in intact rice seedlings[4] and etiolated mungbean (*Phaseolus aureus* L.) cotyledons[5] greening in the presence of light. The influence of penicillin in maintaining chloroplast pigments in isolated leaf discs has also been reported[6]. In view of the hormonal role displayed by penicillin in different plant systems, it was felt desirable to study the effect of penicillin on the rooting of cuttings which is basically an auxin-controlled phenomenon.

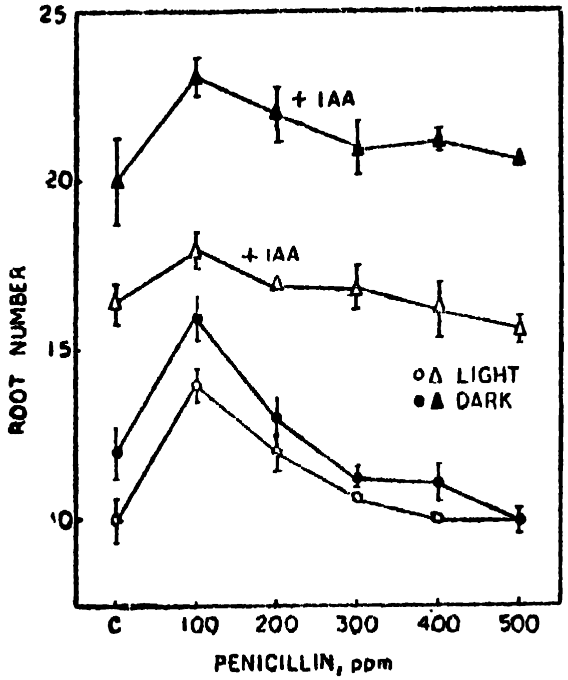

Fig. 1. Mean number of roots per cutting of mungbean in light and darkness when treated with penicillin and IAA singly and in combination with each other. Standard errors are given as vertical bars. Where error bars are not given, the error was smaller than the symbols used for graphing

Mungbean (*Phaseolus aureus* L.) seeds were germinated in the dark in Petri-dishes lined with filter papers containing distilled water. From 5-day-old seedlings, 5-cm cuttings were made each containing hypocotyl, two primary leaves and with or without cotyledons. Penicillin (Benzopenicillin or Penicillin G) was used in 5 different concentrations ranging from 100 to 500 ppm either singly or in combination with IAA (10^{-4}M). For each treatment, 5 sets of vials were employed each with 10 cuttings and 10 ml of rooting solution which was changed at an interval of 2 days. The number of roots formed was counted after 6 days. The effect of penicillin on rooting was determined in both light and darkness and all the experiments were repeated four times.

Penicillin promoted rooting of cuttings when applied singly (Fig. 1). Of all the concentrations tested here, 100 ppm penicillin was found to be the most beneficial to induce rooting, a little less effective was 200 ppm, whereas 300 ppm and higher concentrations were not more effective than simple water. Rooting performance was shown to be better in darkness than in light. It has been previously observed that etiolation of the shoot is beneficial for the rooting of cuttings of a number of plants[7-10] and their observation regarding root-promoting effect of darkness over light supports our present findings. According to their opinion, prevention of photoinactivation of auxin is responsible for root promotion in darkness. On the contrary, the beneficial effect of light has also been described and the light effect has been attributed to the photosynthetic contribution of the leaves and the green stems of the cuttings[11]. In our material kept in light, the intact cotyledons served as an additional source of nutrients apart from photosynthates supplied by the leaves. The absence of any promotive effect of light was further borne out by another experiment in which the cuttings were exposed to light in 2 sets, one with and the other without cotyledons. In both cases, rooting behaviour was the same.

The interaction study shows that the increase in the number of roots per cutting in the presence of IAA in darkness was simply additive. In light, however, these values were less than additive and with higher penicillin dosages were even less than control (IAA 10^{-4}M), thus showing antagonism. From the present investigation, it thus appears that treatment with penicillin may be utilised with success for the vegetative propagation of cuttings.

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Some observations on the biology of *Atherigona Soccata* Rond. (Anthomyhdae : Piptera) on prosomillet in Bihar

The shoot fly (*Atherigona soccata* Rond.) is posing a limiting factor in the cultivation of prosomillet (*Panicum dichotomiflorum* Michx.) at Dholi and its adjoining areas during recent years. Few and scanty information are available on the extent of damage and biology of the pest on sorghum, maize and wheat[4] etc. No work appears to have been done on these aspects in relation to its attack on prosomillet under agro-climatic conditions of north Bihar. Studies on its bionomics and control were, therefore, undertaken at ARI, Dholi in 1980. The present paper, however, highlights the salient findings on the biology of the pest. The temperature and average R.H. during the course of investigations were 29.5±6.13°C and 63.32%, respectively.

The pest attacked the crop in two phases. Firstly, when the crop was in seedling stage lasting for about a month after germination and secondly at panicle-initiation stage. The maggots soon after hatching remained *in situ* for about 30-40 minutes and then crawled on the upper surface of the leaf blade. They moved along the leaf margin between the leaf sheath and the axis. After nibbling on the tissue for a while, they entered into the stem from the lateral side and fed on the growing tip of the central leaf. The infested plants at early stage of growth withered away forming dead heart, while its attach at panicle initiation stage resulted in white earhead formation. Rathore and Sengar[6] made similar observations on its nature of damage.

Female flies laid 29-40 eggs on the undersurface of the leaf margin during morning hours. Freshly laid eggs were smooth, cylindrical in shape and milky-white in colour measuring 0.94±0.12 mm in length and 0.32±0.02 mm in width. The anterior end of eggs turned yellowish at the time of hatching and eclosion of the larva took place on the dorsal side. The incubation period varied from 1-2 days. These observations confirm the findings of Pant and Kundu and Premkishore.[2]

The maggots soon after hatching were dirty white in colour measuring 1.8×0.2 mm in length and breadth, respectively. The maggots passed through four larval instars during growth and development and each instar lasted for 1.10±0.26, 2.48±0.58, 3.31±0.98 and 1.90±0.98 days, respectively. The average larval duration lasted for 8.79±1.69 days. The matured maggot was deep yellow in colour, measuring 6.80 mm in length, and provided with a pair of antennae and stout oral hooks on the cephalic segments. Joshi and Khan[3] made similar observations.

The matured maggot, thereafter, cut a hole in the stem and pupated inside. Freshly-formed pupae were light brown in colour and changed into deep brown latter. The length of the pupae ranged from 3.00 mm to 4.28 mm and were barrel-shapped being circular anteriorly. The pupal period lasted for 8±2 days.

The adults resembled house flies but were smaller in size and remained active throughout the day, mating 3-4 days after emergence. The longevity of male and female flies were 10±3 and 14±3 days, respectively. The finding are in agreement with Soto and Laxminarayana[5].

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A comparative evaluation of some pollen viability tests in ber

The information about pollen viability is a pre-requisite for the success of a breeding programme. The methods employed for testing the pollen viability include *in vitro* germination and stainability. The plant breeders prefer the latter method, because it is less time-consuming. In ber, pollen viability has been tested using both methods[1-6] but results are conflicting. The present study was undertaken to test the suitability of different stains as indicator of pollen viability in comparison with *in vitro* germination in ber (*Zizyphus mauritiana* L.)

Pollen germination was determined by dusting fresh pollen on 25% sucrose medium in cavity slides kept in moist petridishes for 24 hours at 30°C. For stainability 2% aceto-carmine, 1% aceto-orcein and 0.04% erythrosin-B were used. The staining was performed according to the procedure described by Conn *et al*[7]. In each test, approximately 1000 pollen grains were scored. In case of aceto-carmine and aceto-orcein, they were assayed as viable (stained) and non-viable (unstained); the relationship being reverse in case of erythrosin-B.

The data were arranged according to their rank (Table 1) and the correlation coefficients of simple and rank correlations were determined (Table 2). The correlation coefficients of pollen germination with different stains were negative and non-significant. The simple corre-

TABLE 1 : Pollen germination and viability in various ber cultivars

Name of Cultivar	Pollen Germination (%)	Pollen viability (%)		
		Aceto-carmine (2%)	Aceto-orcein (1%)	Erythrosin-B (0.04%)
Ponda	77.00 (1)	58.95 (9)	81.20 (4)	53.59 (10)
Gola	74.10 (2)	70.76 (5)	78.80 (5)	91.65 (2)
Umran	70.80 (3)	74.17 (4)	76.40 (7)	83.86 (3)
Sonari-5	65.30 (4)	67.70 (7)	73.80 (9)	66.30 (7)
Seo	64.80 (5)	81.40 (1)	78.80 (6)	61.10 (9)
Kathaphal	52.30 (6)	30.27 (10)	35.20 (10)	92.27 (1)
Reshmi	51.60 (7)	69.80 (6)	74.90 (8)	65.30 (8)
Banarasi Karaka	27.80 (8)	79.80 (3)	84.80 (3)	90.40 (4)
Sandhura Narnaul	23.50 (9)	66.20 (8)	97.60 (1)	80.30 (5)
Kaithli	22.50 (10)	81.00 (2)	94.50 (2)	75.20 (6)
Illaichi	0.00 (11)	0.00 (11)	0.00 (11)	0.00 (11)

Values in paranthesis indicate rank order.

lation shows stainability with aceto-carmine is closer to pollen germination but rank suggests erythrosin-B to be so. Aceto-carmine and aceto-orcein showed high correlation but since their correlation with germination was poor, they can not be taken as reliable indicators of pollen viability. Erythrosin-B has successfully been used for assaying cell viability[8], but its poor correlation with pollen germination in the present case renders it unsuitable for pollen viability studies.

TABLE 2 : **Correlation co-efficients of pollen germination with pollen viability using different stains and among various stains**

	Aceto-carmine	Aceto-orcein	Erythrosin-B
Pollen germination	-0.1774 (-0.2485)	-0.3702 (-0.3939)	-0.2295 (0.0909)
Aceto-carmine	—	0.8039 (0.2970)	-0.2833 (-0.1270)
Aceto-orcein	—	—	-0.3063 (-0.1394)

Values in paranthesis indicate rank correlation

The pollen germination ranged from 0 in cv. Illaichi to 77% in cv. Ponda (Table 1). Desai and Patil[3] have observed complete sterility in cv. Illaichi and 71.6% pollen germination in cv. Umran which is in conformity with our results. The pollen fertility reported by Singh and Misra[5] in cv. Gola (78.50%) is very close to our observations but their data in cv. Banarasi Karaka (83.95%) deviates drastically from that in the present case.

The pollen germination in 20% sucrose was observed to be about 45% in cv. Umran, Kaithli and Sonari-5[4]. The media with 15% sucrose[2] and 30% sucrose[1] are recommended for testing pollen viability. So the differences in the pollen germination can be attributed to the medium used.

From the present studies, it can be concluded that for testing of pollen viability in ber the *in vitro* germination remains to be the most accurate and reliable method.

The work was carried out under ICAR scheme on arid zone fruits.

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A Hematological study of Marbled Balloon frog *Uperodon systoma* Schneider

Hematology of *Uperodon systoma* has been reported for the first time in this study. It is a burrowing frog available in plenty during the monsoons. Observations were made on these frogs available in Bhubaneswar located 25 m above sea for a period of two years (1979 and 1980). Blood samples collected in heparinized capillary tubes were centrifuged and hematocrit percent (packed cell volume) was determined by a hematocrit-measuring scale. Total erythrocyte and leucocyte counts were made according to the method described by Dacie and Lewis[1] by a hemocytometer, using amphibian saline (0.65%) with gention violet as RBC diluting fluid and 0.1 N HCl with neutral red (1% in 0.1 N HCl) as WBC diluting fluid. Hemoglobin concentration was determined in a hemometer. Leucocyte differential count was made by staining a thin smear with Leishman's stain. The pH of blood was determined with pH paper with fractional range between 6.0 to 8.0 (Merck, Germany).

Sexual dimorphism in this frog was reported for the first time in most of the hematological parameters (Table 1). WBC total count, hemoglobin gm%, hematocrit percent and neutrophil percent were significantly higher ($p<0.05$) in males than females. The difference in other hematological parameters between males and females were insignificant.

TABLE 1 : **Hematological averages for *Uperodon systoma* (10 individuals in each sex)**

Blood value and cell type	Sex	Mean $(\bar{X})$	S. E. of $(\bar{X})$
Erythrocytes in million (per mm^3)	♂	1.23	0.22
	♀	1.72	0.12
Leucocytes (Per mm^3)	♂	22220	1783.98
	♀	16100	1072.58
Hemoglobin (in gm/100 ml.)	♂	12.14	0.34
	♀	9.02	0.66
Hematocrit (in % cell)	♂	42.3	3.25
	♀	34.2	1.67
pH	♂	7.3	0.03
	♀	7.3	0.03
Lymphocyte (%)	♂	40	2.64
	♀	54	2.62
Monocyte (%)	♂	11	0.97
	♀	13	1.85
Neutrophil (%)	♂	48	3.18
	♀	32	2.48
Eosinophil (%)	♂	0.7	0.26
	♀	0.8	0.39
Basophil (%)	♂	0.1	0.1
	♀	0.1	0.1

The erythrocytes are elliptical in shape with centrally located nucleus. The average size of long and short axes of erythrocytes were 14.43 μ and 10.88 μ respectively. The spindle shaped thrombocytes had an average long and short axes of 11.42 μ and 4.77 μ respectively. The following five types of leucocytes with corresponding mean diameter sizes, given in the parenthesis were noted in *U. systoma* : Large lymphocyte (9.77 μ), Small lymphocyte (5.88 μ), Monocyte (7.77 μ), Neutrophil (8.88 μ), Eosinophil (9.62 μ) and Basophil (7.22 μ).

Reports on the hematology of amphibians of India is very scanty[8-9]. Amphibian blood cells are of mammalian type except that the erythrocytes are oval and nucleated. Besides the characteristic oval red blood cell shape, varying degree of irregularities ranging from pointed at one or both ends to cone shape, were observed. Small polychromatic red blood cells were also observed occasionally. Lymphocytes are spherical in shape with a large nucleus occupying almost the entire cell. Occasionally a small ring of cytoplasm around the nucleus could be discerned. Monocytes were easily distinguished from lymphocytes by their kidney shaped nucleus. Polymorphonuclear neutrophils did not appear granulated. The nucleus usually appeared in an eccentric position. Eosinophils showed bright red with thick round granules against a light pink cytoplasmic background. Basophils had a large round centrally placed dark blue stained nucleus with pin-headlike darkly stained granules. Only two basophils could be observed in this study. Thromobocytes, the lower evolutionary counter part to human platelets, appeared as small refractile bodies. Since hematology of this frog has been reported for the first time in this report the results depicted in this study is basic in nature and further studies are needed to be done.

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Effect of phenylhydrazine hydrochloride on the blood sugar level of Lata fish (*Channa punctatus*)

Earlier studies indicate a hypoglycæmic effect of hydrazine on different animals[1,2]. The fasted dogs injected with hydrazine show within 90 min after injection a hypoglycæmia which continues till death of the animals[3]. On the other hand, hydrazine can produce hyperglycæmia[4]. Poisoning with phenylhydrazine causes a long-term hyperglycæmia[5]. O'Brien *et al.*[6] have also shown elevated blood sugar level with different hydrazine compounds. Isoniazid increases the level of blood sugar[7]. But hydrazine treatment in both dogs and rabbits induces hypoglycæmia. It appears, therefore, that both hypoglycæmia and hyperglycæmia occur in higher animals after treatment with hydrazine and its derivatives. Moreover, depletion of liver glycogen has been shown by phenylhydrazine injection in dogs. In course of investigations on the effect of different doses of phenylhydrazine hydrochloride (PHH) on various physiological parameters in Lata fish, it has been found that a decrease in glycogen content of liver takes place after PHH injections[8]. This observation prompted us to extend our investigations on the effect of PHH on the blood sugar level of Lata fish (*Channa punctatus*), since, to our knowledge, such study has not been reported on this type of fish. Based on our observations[8], a suitable dose of 4.0 μg of PHH per gram of body weight of fish was selected for the present study.

The Lata fishes of 25-32 gram body weight were divided at random in different groups for the experiments. Each fish was maintained in 1 litre of tap water in glass jar at 25°C±1°C, and the medium was changed every day. Phenylhydrazine hydrochloride [Loba-Chemie Wien-Fischamend (Austranal-Praparate)], dissolved in 0.65% NaCl solution, was injected intraperitoneally at the dose of 4.0 μg/gram of body weight of fish on the zero day, and on the 4th, 8th and 12th days. The injected volume was within 0.1 ml. The control fishes received the same volume of 0.65% NaCl solution. All the experimental fishes were starved during the experimental period. The Lata fishes were killed for drawing blood on the 4th day after the last injection, i.e. on the 4th day in case of single injection, on the 8th day in case of two injections, 12th day in case of three injections and 16th day in case of four injections. Blood was drawn carefully avoiding the hemolysed blood. Hemolysed blood was not generally found after four days of PHH injections. The blood sugar level was estimated by following the method of Nelson-Somogyi[9,10]. The results were statistically analysed by using student t-test. Each treated or control group consisted of 20 fishes.

The blood sugar level of the fasting control Lata fishes during the experimental period varied from 77.50 to 83.51 mg/100 ml of blood. Compared to the respective control, the blood sugar level was increased by a single and repeated injections (2, 3 and 4 injections, each at four days interval) of PHH at the dose of 4.0 μg/g (Table 1). The increase in frequency of PHH injections from one to two or three injections was accompanied by an increase in blood sugar level. When the fishes were given four injections of PHH, the elevated blood sugar level was found to be about the same as observed after two injections, but the level was higher in comparison to the level obtained after a single injection of PHH. There was no statistical difference in results with respect to increase in blood sugar level among the two, three and four injections groups.

assumed by the fact that asphyxiation hyperglycæmia occurs in fresh water fish[12]. It may be a fact also that rise in blood sugar concentration in PHH treated Lata fish is the result of reduced utilization of blood sugar due to the reduction in erythrocytes number by PHH treatment. It is also known that insulin level in blood is reduced by hydrazine treatment[13]. In our treated fish, it is difficult to explain at present whether or not PHH elevates the blood sugar level by affecting the insulin level of blood. Whatever may be the mechanism involved, there is a definite relationship between the reduced liver glycogen content and a concomitant enhancement of blood sugar level in PHH injected Lata fish.

TABLE. **Effect of phenylhydrazine hydrochloride (4 μg/g, single injection, and repeated injections – at four days interval) on blood sugar level (mg/ 100 ml blood) of Lata fish (*Channa punctatus*). The day of first injection was taken as zero day. The animals were starved during the experimental period. Each group consisted of 20 fishes.**

No. of injections	Day of blood drawing	Control Mean ±S.E.	Treatment Mean±S. E.	P value (Control-Treated)
1	4	78.90±4.13	98.59±3.49 (A)	<0.01
2	8	83.51±3.80	110.21±4.00 (B)	<0.001
3	12	78.67±4.70	116.36±5.00 (C)	<0.001
4	16	77.50±4.20	110.71±4.30 (D)	<0.001

S. E. = Standard error. t-test probability differences between different treated groups : A-B = $P<0.05$; A-C = $P<0.01$; A-D = $P<0.05$; B-C = NS ; B-D = NS ; C-D = NS.
NS = Not significant.

It is evident that the elevated blood sugar level in Lata fish after single or repeated injections of PHH remained below 120 mg/100 ml of blood. For this reason, this rise of blood sugar may not be termed as hyperglycæmia. It can be pointed out that the control Lata fishes in fasting condition during the period of experiment showed no significant variation in blood sugar level. Similar reports have been made by others[11]. It is obvious that increased blood sugar level in Lata fish after PHH injections may be due to glycogenolysis in liver, since it has been found in course of our investigations that the liver glycogen content declined significantly after PHH injections[6] thus contributing to the rise of blood sugar level. The PHH-induced asphyxia due to low hæmoglobin content may be one of the causes for increased blood sugar level in Lata fish. This may be

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Sexual dimorphism in the cyprinodontid weed fish, *Oryzias melastigma* (Mc Clelland)

Sexual dimorphism in fishes is mostly associated with variation in length of fins, genital papilla and colour pattern[1-8]. The present paper deals with the sexual dimorphism of *Oryzias melastigma* (Mc Clelland) under family Cyprinodontidae which is not reported before.

This tiny weed-fish is most common in West Bengal, Kerala, Tamil Nadu and Bangladesh[9] and is generally found in gutters, paddy fields, derelict ponds, foul waters and also in brackishwater areas.

A number of juveniles and adult specimens have been collected from different water areas of gangetic West Bengal during the period of August, 1982 to July, 1983.

From the intensive study of the specimens of *Oryzias melastigma* (100 numbers of specimens of each sex were studied and size ranges from 23 to 29 mm in male and 21 to 30.5 mm in female), the authors come to conclude that this species shows pronounced sexual dimorphism (Fig. 1) in their fin features. The anal and the dorsal fin of males (Fig. 1b) are filiform and larger than the female (Fig. 1a; Table 1) ones where fins are unfiliform, smaller and with more or less rounded outer edge.

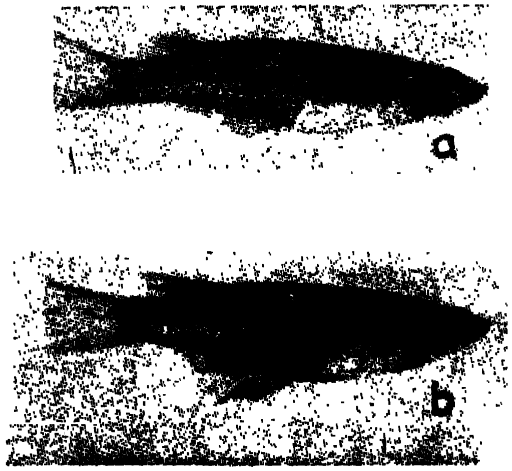

Fig. 1. *Oryzias melastigma* (McClelland): Lateral view of female (a) and male (b).

TABLE 1: Sex, total length, height of the dorsal fin and anal fin (mean ± S.E.) in 20 fishes of each sex group

Sex	Total lenght (mm)	Height of the dorsal fin (mm)	Height of the anal fin (mm)
Male	25.47 ± 0.36	4.93 ± 0.09	5.67 ± 0.10
Female	26.02 ± 0.48	3.69 ± 0.09	3.66 ± 0.09

A few authors[9-10] have given the description of *Oryzias melastigma* and only mentioned filiform rays of anal fin in some of the specimen as individual variations. But the variation of dorsal fin is not mentioned.

The type specimen described there was not given the sex. It seems that the described specimen was female one and they considered male-fin features as a variation from the described female type.

The present investigation reveals the diagonostic features of anal and dorsal fin in male and female. In other taxonomic characters, both the sex do not show any difference.

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Effect of artificial saline water on methane production

The need for alternative energy supplies is increasingly becoming apparent. Our fossil fuel reserves will eventually be distributed and are becoming too costly for many countries that must import them. The present energy generating systems in the developing countries depend largely on such local resources as wood or dung. Of these, dung is underexploited. Dung can be conveniently used for methane production by anaerobic digestion. The gas thus produced has several uses in the form of mechanical, heat and light energies. Since dung and water form the basic materials for methane production, the quality of water used in production of biogas assumes a great importance and the ground water in arid and semi-arid region generally contain high amount of salt. The present study was conducted to know the effect of artificial saline water on methane production. ·

The combination of NaCl and CaCl$_2$ in equal proportion was used in preparing saline water electrical conductivity (EC) levels, viz. control (distilled water), 1, 2, 4, 6 and 8 mmhos/cm at 25°C. A portion of 600 g cattle dung and saline water at different levels were mixed on equal proportions and filled in winchester bottles. Provision was made to collect the gas by downward displacement of water. The bottles were sealed soon after introducing the treated mixtures. The gas thus produced was measured with the help of measuring cylinder and methane was tested by burning it.

TABLE 1 : Effect of artificial saline water on methane production

Treatment	pH of the main media	Time taken to produce methane (days)	Quantity of methane produced (ml)	Per cent increase or decrease over control
Control	7.75	13	11,565	0.0
1 EC*	8.40	13	36,750	+223
2 EC	8.30	11	26,215	+127
4 EC	8.30	13	1,300	-89
6 EC	8.00	—	@	-100
8 EC	8.05	—	@	-100

EC* : Electrical conductivity (Milli-mhos/cm) at 25°C

@ : Did not produce any gas during the duration of experiment.

The results of the experiment are presented in Table 1. Higher amount of salinity, i.e. 6 EC and 8 EC was ineffective in producing any methane gas. Higher salt concentration curtailed the activity of methanogenic organisms, fully resulting in the cessation of gas production may be a probable reason. The results are in conformation with the findings of Pfefter[1]. An increase in EC is associated with a decrease in the amount of gas produced. 1 EC solution gave 36,750 ml methane (223% moreover control). There was a reduction in methane production (26,215 ml) when the EC was increased to 2 (127% moreover control). Further, when EC was increased to 4 only 1300 ml of methane gas was produced (89% less than control). The other two treatments were totally inefficient in producing any methane gas. Presently, it appears that 1 EC saline water can be effectively utilized as it goes 223 per cent more methane than using distilled water (11,565 ml). Under situations where saline water is available for use, such waters can have up to 2 EC.

Any higher salinity would reduce the efficiency of methane production. This indicates that salts at lower concentration (<2EC) stimulated the growth and activity of methanogenic organisms as reflected in higher methane production. The present study clearly indicates that salt concentration beyond the level of tolerance affects the methanogenic organisms possibly by reducing water potential and in turn causing severe reduction methane production.

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Occurrence of root-knot nematode in Congo jute

Congo jute (*Urena lobata* L.) is a member of Malvaceae which yield a fibre from its stem. The plant is found in several countries in the warmer regions including India.

Urena sp. is highly resistant to attacks by nematode[5]. *Heterodera marioni* (now called *Meloidegyne incognita*) was reported from *Urena* in Zaire (Belgian Congo)[4]. The resistance of *Urena* to nematodes that attack kenaf in highly infested soils is observed in Ghana[1]. There was no evidence of nematode attack on *Urena*, grown on nematode-infested sandy soils in North Florida, although kenaf in adjoining plots had heavy attack[3].

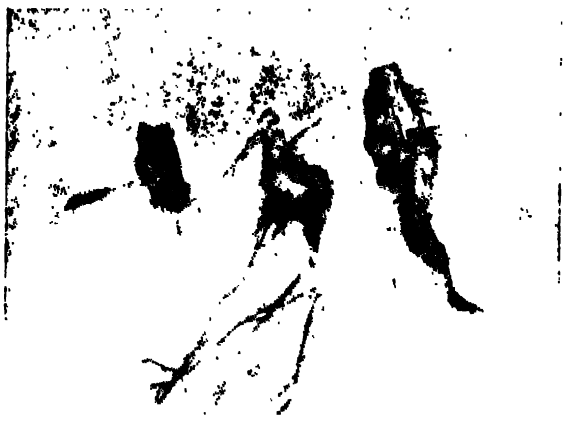

Fig. 1. Composite galls in the tap root

At the main farm of the Jute Agricultural Research Institute, West Bengal, some plants of *Urena lobata* of Block No. 13 had the presence of galls in the anterior part of the tap root as well as lateral roots. The galls on the tap roots were bigger in size and composite in nature (Fig. 1). Most of the swellings on the roots were within the range of the 2-6 cm depth from the soils surface, though *Urena* sp. has a tap root of about 20-25 cm in length and a secondary root-system which is lateral and running, the axes of which decrease in depth.

The galls on the roots are evident in the field when the plants attain 4 months croppage, i.e. November onwards. In the younger plants, galls were hardly observed.

Examination of the galls when teased under magnification (×36) of the microscope showed the presence of egg-masses in different phases of their development and mature females of nematodes.

The nematodes belong to the genus *Meloidogyne* and they are identified as *M. incognita* (Kofoid and white) Chitwood[2]. This is the first report of *M. incognita* on *Urena lobata* L. from India.

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Leaf blight of large cardamom caused by *Colletotrichum* sp.

Large cardamom (*Amomum subulatum* Roxb.) is an important cash crop of Eastern region of India and Kerala. During July-August (1982) some plants in a kitchen garden near Bihar University campus, Mazaffarpur were found heavily infected with a blight disease. The pathogen was isolated from diseased leaves, grown on Potato-dextrose agar slants, and identified as *calletotrichum* state of *Glomeralla cingulata* (Stonem.) Spauld. and Schrenk by Dr. J. E. M. Mordue of Commonwealth Mycological Institute, Kew, England (IMI 273012).

Pathogenicity of the fungus was established after completion of Koch's postulates. Leaves were first injured by sterilized needle, sprayed with spore suspension and covered with moist polyethylene bags. The characteristic disease symptoms appeared four days after inoculation.

Initially light brown irregular spots appeared along the margins of leaves. These spots gradually advanced towards the midrib and turned reddish brown. At the advanced stage of disease, the leaf margin showed frilled appearance and the whole leaf dried up.

A thorough perusal of literature[1] reveals that the blight disease of *Amomum subulatum* caused by *Colletotrichum* sp. is an unrecorded disease and hence, is being reported for the first time from India.

Our thanks are due to Dr. Mordue of CMI, Kew, England for confirming the identity of pathogen.

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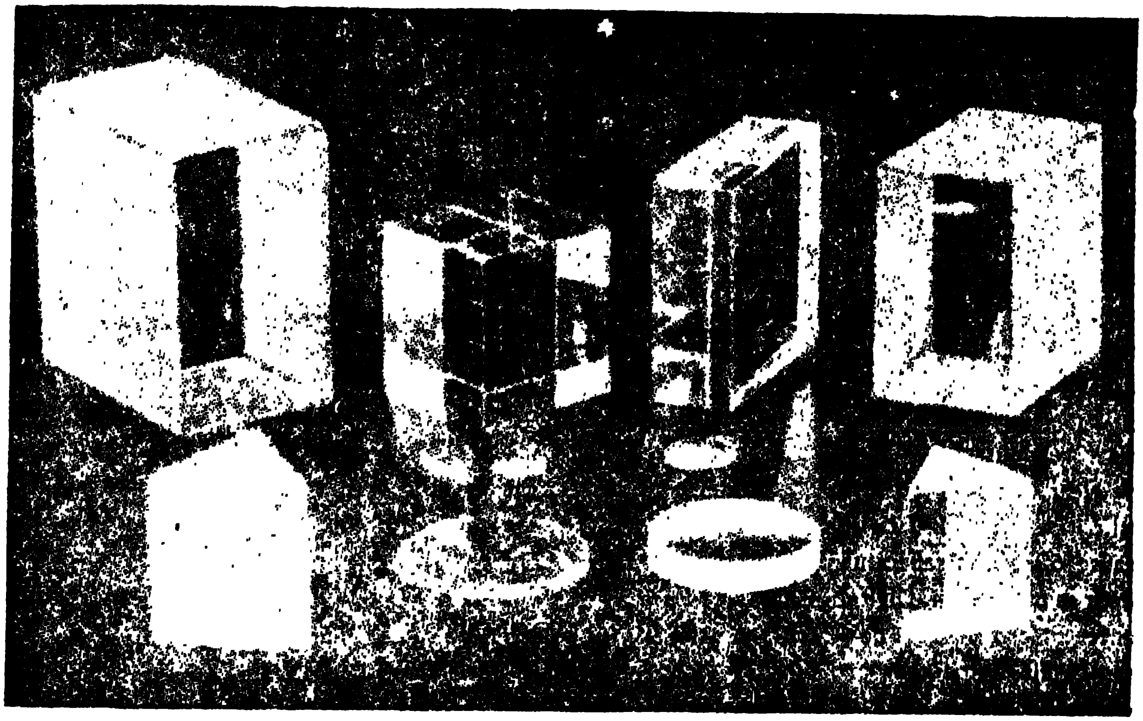

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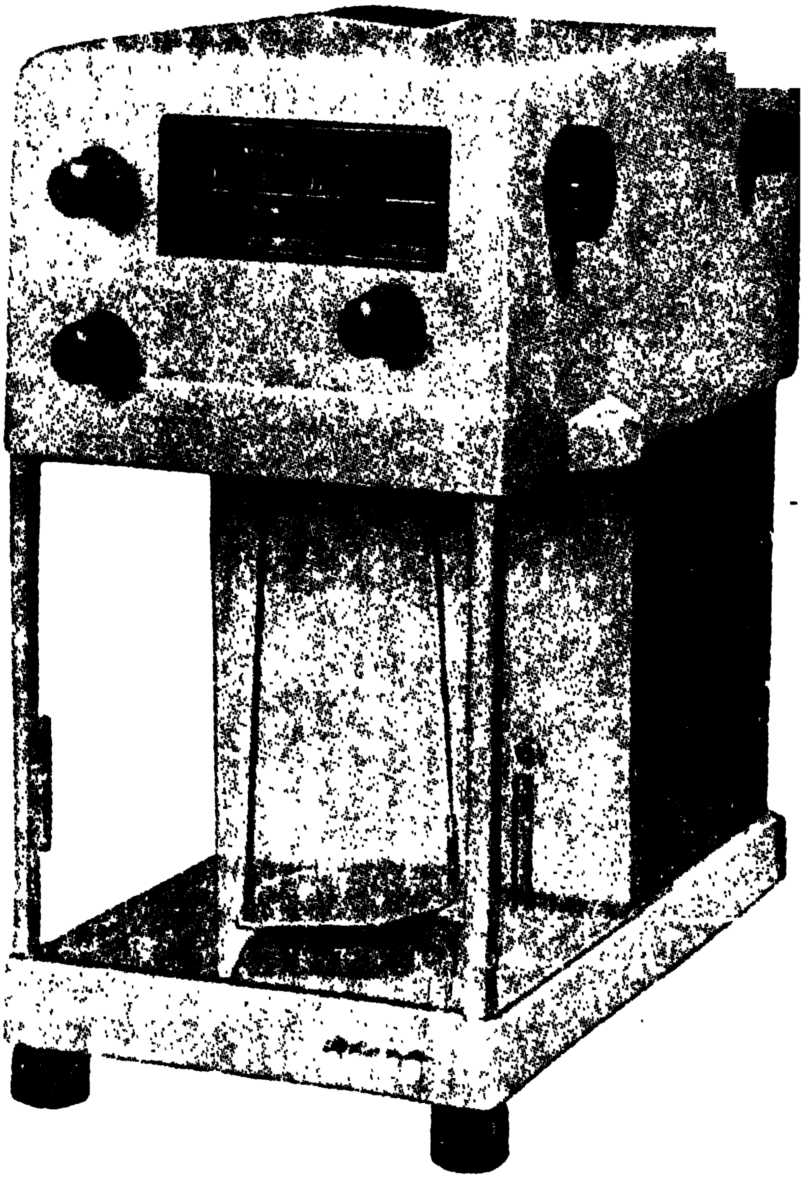

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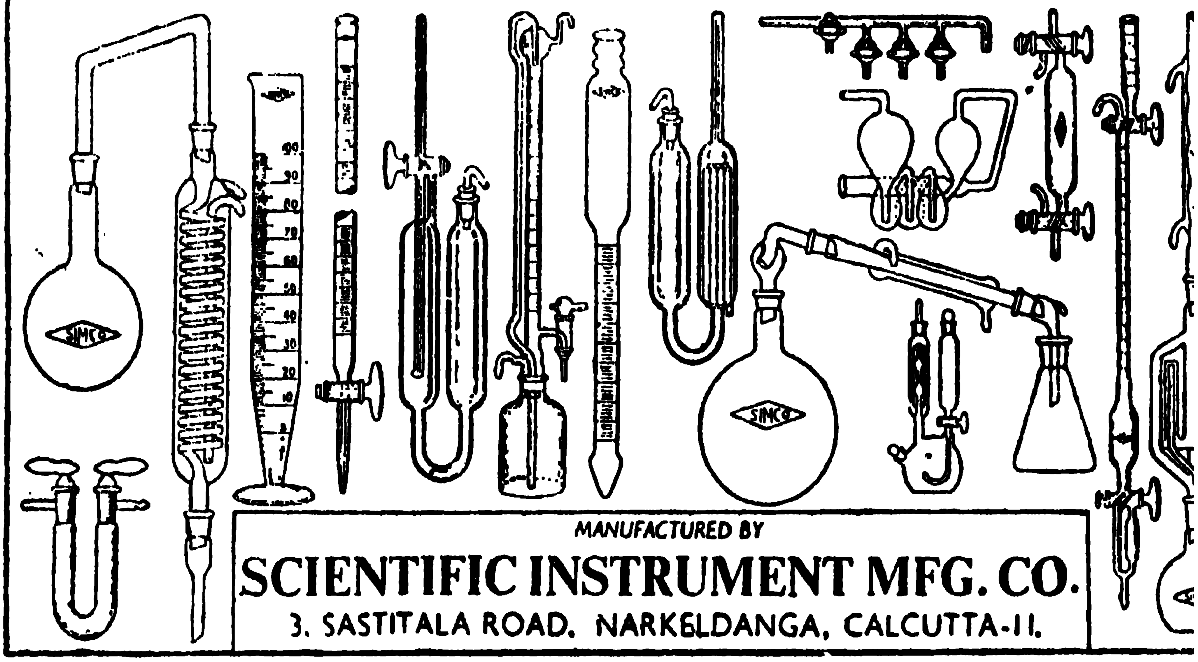

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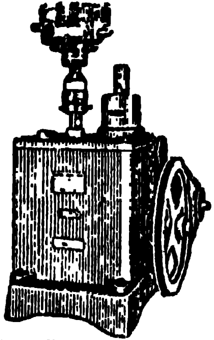

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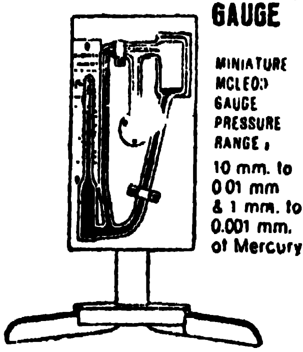

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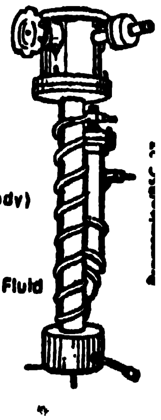

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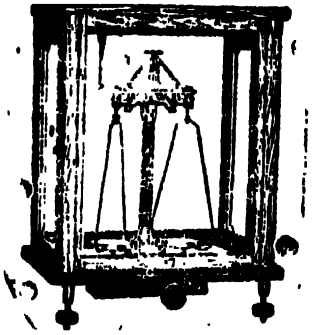

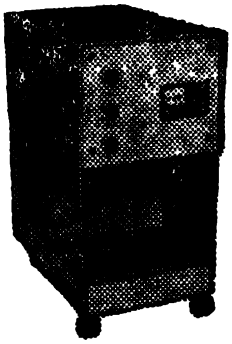

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SCIENCE & CULTURE

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THE GREAT BHOPAL TRAGEDY

IN the late fifties of this century the developed countries of the West started feeling the effect of the man made chemical pollution of the environment. In the United States, just before Thanksgiving of 1959, cranberries contaminated with the weed killer aminotriazole, known to cause cancer in rats at even low doses, had had to be withdrawn from the market. Then followed the thalidomide tragedies, when mothers who had taken the drug during pragnancy gave birth to severely deformed children all over Europe. These well publicized events and a number of other incidents in the American life led Rachel Carson to write the famous book 'Silent Spring' in 1962 which exploded on the Western world like a bolt from the blue and it sounded the death knell to many chemical, fertiliser and pesticidal companies. Long law suits were instituted but the well researched facts presented in the book prevailed. Little did I think at that time, working in the laboratory of the Columbia University that India will be faced with the man-made pollution problem in such a short period of time.

The writing of the book 'Silent Spring' was actually prompted by the fervent appeal by a nature loving friend, Olga Huckins of Carson, to do something about the aerial spraying of DDT. Huckinses had a private bird sanctury in Duxbury, Massachusetts which had been doused with DDT when the state sprayed the surrounding areas in an attempt to control mosquitoes. The graphic description of the agonising deaths of the birds by Mrs. Huckins moved Carson to do something. Her determination was further strengthened with the sueing of the government by the citizens of the Long Island to protest against aerial spraying of DDT over heavily populated suburban areas to control the gypsy moth. The government always assured that the spraying was harmless.

Unlike the researches for the earlier three famous books, on and about the Sea, Rachel Carson realised the explosive nature of the topic in hand and the tremendous pressures against her from pesticide related industries and institutions. She was determined to write the book and she accomplished her mission before dying (ironically) of cancer in 1963.

In the highly poetic sections of the silent Spring there is a 'Fable' of a horrid disaster about which Carson hastens to assure her readers that the town where all these things have happened does not exist. However, the events did take place though 14 years later. In the book, Poison that Fell from the Sky, John G. Fuller dramatically described a pesticide accident at a factory at Seveso, Italy, near Milan, where huge quantities of the toxic chemical TCP (Trichorophenyl) entered the atmosphere in 1976. The myth of the Silent Spring was changed to tragic reality. The Bhopal disaster is an unprecedented man inflicted tragedy in the entire history of humanity till today and a grim warning for the future.

The scale of the tragedy which struck Bhopal in the early hours of December 3 leaving several thousands dead and many more hospitalised has no precedence in history except may be during wars. The manner in which the poisonous gas leaked from the Union Carbide plant on the outskirts, spread southwards over the city in the still of the night and took people's lives in the midst of their sleep makes the incident a foretaste of a chemical warfare. Official figures put the death toll at around 2000, while local estimates give it ten times higher. The latter may well be an overestimation, as can be expected from the first flush of reaction from a panic striken populace. But the true figure is in all likelihood several thousands more than the official one. Besides, nearly one fourth of the city population of over 8,00,000 is estimated to be affected by the exposure to the poisonous gas, with more than 25,000 of them inhaled it in sufficiently large quantities to make them vulnerable to serious long term hazards. A substantial section of them have already been affected with abnormalities such as loss of vision (may be temporary) hemiplagia, kidney trouble and severe malfunctioning of the respiratory tract.

The world was only slowly recovering from the shock of the industrial accident in which a natural gas explosion on 17 November 1984 at the Pemex plant of Petroleos Mexicanos in the suburbs of San Juan Ixhuetapec. It flashed the skies with hellish waves of orange, red and black and devasted the shanty town surrounding the plant. More than 30 acres of working class housings were destroyed and another 30 heavily damaged. A series of explosions not only destroyed four spherical tanks, each holding at least 420,000 gallon of liquified gas but also sent enormous shards of steel speared into the houses. The official figures of casualties were 365 dead and 2000 injured with the third of the injured not expected to live. Seveso accident (already cited) is chemical industries' own which back in 1976 simply dropped poison from the sky over the unwary people. Chemical industries are also familiar with other industrial accidents in which large number of their employees were affected. In 1963, in Amsterdam the Duphar Chemical plant's reactor vessel for Trichlorophenyl production over-heated and exploded.' About a ton of chemicals, 200 to 500 gms of dioxin showered the interior of the works. The exact number of employees exposed to the chemical by the explosion and during the subsequent cleanup is not certain, but is thought to be at least 145, a large number of whom later came down with dioxin poisoning. However,' the Bhopal accident dwarfs all these in magnitude of scale.

The gas, now known as methyl isocyanate (MIC) had leaked from the pesticide plant of the Union Carbide (UC), a multinational company. This highly toxic gas is used as an intermediate organic chemical by UC in the manufacture of carbaryl (brand name sevin) and temik (also known as aldicarb). Many of the intermediaries used in the pasticide industries are toxic and harmful in different degrees. Sevin and temik have very different tolerance level values (TLV) in formulation though both use MIC for their manufacture. For sevin it is 800 mg/kg whereas it is as low as 0.8 mg/kg for temik. Both sevin and temik are broad spectrum pesticides. Because of its high toxicity, Industrial Toxicological Research Centre (ITRC) Lucknow, once thought of banning temik. It would be unwise to think in terms of banning pesticides in general, because they have been the reasons for increased food production in the country over the years and they will continue to be beneficial only if the safety regulations in their manufacture and use are strictly enforced and adhered to.

Since about 1944, pesticides came into fairly wide use in the country, though the manufacture was started only in 1952. Among the South Asian and African countries, excluding Japan, India is the largest manufacturer of pesticides today. About 125 pesticides have been registered with the central Insecticide Board (CIB), Faridabad, of the Ministry of Agriculture and licensed for production and use.

The Insecticide Act of 1968 sets out the guidelines for the CIB to scrutinise every application for manufacture or marketing of pesticides. A later addition to the report also lays down the procedure for providing the basic data and information related to toxic effects at various stages of preparation of the production. However, over the years, with the increase in the number of pesticides, manufacturing processes and enterpreneurs, these guidelines have been rendered non-functional. The CIB does not have the necessary infrastructure and facilities to check the information provided in each case. The word of the enterpreneur is taken for granted. If highly sophisticated technologies and processes of high toxic new products are transplanted from abroad, where they had a record of operation without problems, they are approved without evalution and checking the suitability to our environment. Thus the act itself has been reduced to a sort of red tape, and has become, like many other government procedures, a vehicle for wide-spread corruption.

The agency (CIB) has no periodic monitoring programme of working conditions at the factories, no inspection for ensuring that safety measures are provided, no checking of the production capacity nor estimating the atmospheric concentration of toxic material near the factory site. In fact, it is doubtful whether the agency has at its disposal, either at the central or state level, persons suitably qualified to undertake the above mentioned supervision.

With this state of affairs it is not surprising that the accident in Bhopal took place and with the complementary conditions assumed the gigantic scale of a disaster. If one delves into the accident history of this Union carbide factory or for that matter many other chemical factories in the country it is rather dismal. It is only non-conducive circumstances that have saved many a situation.

The 30 tons of killer gas, which escaped into the atmosphere from the underground storage tank, on the night of 2nd December 1984 in Bhopal, reliably learnt to be methyl isocyanate (MIC), is one of the most toxic gases known. The unique properties of MIC (chemical formula $CH_3 - N = C = O$, molecular weight 57.05) are that it is highly volatile (Boiling point somewhere between 37°C to 45°C, flash point $-7°C$) and inflamable ; its vapours (vapour density 2.2) are denser than air. This colourless liquid with a powerful odour is stable under dry and neutral conditions at room temperatures but can react violently in the presence of acids, alkali, water and other organic nucleophiles (electron-rich). The organic isocyanates are known as carbamylating agents (they lead to products known as carbamates). The carbamate insecticides are effective against several insect pests causing crop losses. Its low mammalian toxicity with high insecticidal action have taken them to domestic application (Baygon spray).

When the people thronged the hospitals in large number after the Bhopal accident, doctors were hard pressed to follow any definite line of treatment. For quite some time the killer gas was not identified and there was confusion whether it was phosgene or MIC. Once it was announced they found scanty information about the action of MIC on humans, animals or other living things. Their information only described MIC as a volatile, colourless and lachrymetory (tear producing) liquid highly irritating to skin, eyes and mucous membranes and can cause pulmonary edema. So it is not surprising (now) that the company could not provide any information on the possible line of treatment for the affected persons.

Now scientists in the country have put together various informations gathered from the tragedy. The observed physical effects in the Bhopal accident were excessive tear formation, congestion in the windpipe, pulmonary edema, and increased movements of the bowels and urinary bladder. These effects have now been understood from the point of view of extreme reactivity of MIC with compounds containing hydroxy ($-OH$) and ($-NH_2$) groups. Proteins and certain useful enzymes in the body contain both these groups and the reaction of MIC which forms new compounds either blocks or incapacitates the groups from its normal function.

Choline is an essential metabolic compound in an animal organism which builds and maintains the cell structure. It is strongly hygroscopic and forms an ester, acetylcholine, with acetic acid. Now acetylcholine is an important chemical which is released at the nerve endings in the human body. Acetylcholine controls the secretions of various glands which produce tears, saliva, mucus, stomach acidity, etc. It is also known to be responsible for the regulation of the activities of skeletal muscles, which control the body movements, and smooth the function of muscles which are present in the wind pipe, stomach, intestinal walls and urinary bladder. Under normal conditions, an enzyme called acetylcholinesterase prevents accumulation in the body of acetylcholine by hydrolysing it to choline and acetic acid. In this splitting the hydroxy group of the enzyme plays an important role. If the hydroxy group is blocked by reaction with other compounds such as MIC, the enzyme becomes inactive, acetylcholine content builds up in the body, which in turn produces many undesired symptoms (already mentioned).

Another effect of the toxic gases is to damage the thin walls of the blood capillaries through which water, oxygen and carbondioxide exchanges takes place. As a result water starts leaking and pools in the surrounding tissues, giving rise to edema. During pulmonary edema respiration is effected in this manner. This is most important, severe and common human response to toxic gases and it was evidenced by the Bhopal victims too. The long term effect depends upon the extent of the damage in the body.

Let us now try to understand the fate of MIC in the environment. An estimated 30 tons of MIC leaked from the tanks and spread over the whole volume of two kilometers radius upto a height of (approximately) 30 m. This works out to about 0.03 ppm of MIC, which is above the safe upper limit and as it is heavier than air, the concentration would have been much higher near the ground surface.

However, MIC will undergo degradation due to sunlight, as well as reactions with the moisture. Methamine, dimethyl urea and harmless other gases are the likely major products. In plants, MIC could compete with CO_2 in photosynthetic processes. As in human system, plants will also produce methylamine and other carbamylated derivatives of the plant constituents.

Thus in predicting the long term effects of the MIC contamination one has to consider the effect of this excess methylamine which is the major metabolite. According to the studies carried out at the Jefferson Medical College, Philadelphia, aliphatic amines are likely to participate in the complex metabolic derangements occurring in renal failure. In the cases of patients with kidney diseases, definite clinical toxicity was demonstated with methylamines.

There are many speculations about the causes and lapses which led to the accident at Bhopal. In the initial heat of emotions and anguish the total blame has been placed at the doors of the multinational company, the Union Carbide. It holds 51 per cent of the shares in the Indian company which is managed primerily by the principals through the Indian board. There are many questions yet to be answered and already governmental and non-governmental committees are enquiring into the various aspects of the whole disaster. It is sure that some exothermic chemical reactions were initiated in one of the tanks induced by some foreign substances (which may well be a seepage of water) which led to sudden building up of high pressure and leading to the catastrophe. What these enquiry committees have to see is not only the causes that led to the accident but also possible measures in minimising, if not eliminating altogether, the probability of recurrence. After all we cannot shut down the use of chemicals permanently. MIC is one of a group of widely used chemical not only in insecticides and pesticides, but also in paints and varnishes.

If chemicals bring risks that are less than those brought by the pests they destroy and other benefits they bring to humanity, then all countries, poor or rich, have every right to choose to use these chemicals. When accidents occur they do so because of human lapses in one form or other. They do not differentiate between poor and rich countries. Seveso, Pemex or the dioxin accidents in Amsterdam and England which preceded Bhopal, occurred all over the world. The lessons are to mankind as a whole, to be cautious about taking it easy with modern technology.

We in India too should introspect about our policies, attitudes and morals. We do not hesitate either to claim the laurals of indigenisations when success is achieved in any enterprise, or in the face of disaster do we hesitate to drop the blame squarely at the doors of a scape goat. The Bhopal accident and its aftermath have put the intelligensia in the country in a dilemma and have led the common man to confusion. Many investigating committees have started looking into the causes that led to the disaster. Let them report clearly and unequivocally on the very type of neglect that the management allowed to perpetrate and the Government safety law enforcing agencies overlooked. Let the guilty be brought to book and corrective steps be taken immediately. Let us convert this great tragedy to the ushering in of a sound technological and industrial policy in the country and proper enforcement and execution of all environmental safeguards. ☐

B. B. Baliga

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Unique Biogeographic realm

India has a unique bio-geographic position which is in the confluence of palearctic Ethiopean, Indo-Malayan and Indo-chinese realms of fauna and possess a number of components from each of these realms. The Ethiopean region is represented by chinkara, the hyena and the ratel; the palearctic by lynx, wolf, markhor, urial and hangul; the Indo-chinese by red-panda and the mask deer; the Indo-Malayan by the hoolock and gibbon, the elephant, the goat antelope, and the mousedeer.

India along with south-eastern Asia forms a part of the oriental region. This is one of the six great geographical realms into which the earth is divided. Each of these realms supports its characteristic animal life. The Indian region has varying physical characteristics along with a great variation in climate and vegetation. Zoo-geographically India can be divided into several zones which are: (i) Malabar coast, (ii) Main peninsula, (iii) Gangetic plain, (iv) Indian desert, (v)

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Deccan thorn desert, (vi) Punjab and its semi-arid desert, (vii) Ladak and its cold desert, (viii) Assam and contiguous hills, (ix) Wooded hill slopes of the Himalays, (x) Andaman and Nicobar islands, etc.

The distinct zones are indicative of the richness of fauna of the Indian sub-continent from ecological and bio-ecological points of view. India's unique diversity in fauna stems from her ecological variations typified by hot rainless deserts, cold snowbound mountain peaks and wet and soggy rainy regions.

National wildlife action plan

It is relevant to mention here that a National wildlife action plan has been drawn by the Department of Environment. It identifies ten important phases of actions as shown under :

(i) Establishing a net work of scientifically protected areas such as national parks, sanctuaries and biosphere reserves to cover adequate geographical areas.

(ii) Developing appropriate systems of management concerning protected areas and restoration of the degraded areas.

(iii) Building up a professional cadre of personnel fully trained for the management of sanctuaries.

(ix) Providing corridors linking all the sanctuaries of a particular area or zone.

(v) Rehabilitating indigenous, endangered and threatened species of fauna and flora.

(vi) Supporting the managemet of captive breeding programmes for plants and animals.

(vii) Developing research and monitoring facilities.

(viii) Promoting support for wildlife education and research.

(ix) Revising statutory provisions providing protection to wildlife and regulating all forms of trade in wildlife.

(x) Enlisting support from and collaborating with voluntary bodies and agencies in the total wildlife conservation effort.

Threatened and endangered species

This article is not the proper place to give a comprehensive list of the threatened species of fauna and avifauna. Several species have been extinct and many others are threatened with extinction. The hunting leopard, the two horned rhinoceros and the pink headed duck are few amongst others which have been extinct. At least seventy one species of mammals, seventeen species of amphibians and reptiles and forty seven species of birds face the threat of extinction. Apart from the vertebrates, crustaceans are also on the point of extinction and special mention in this connection may be made of the robber crab of south sentinel island.

The time is ripe for the conservationalists to devote more attention to keep alive the following species to preserve India's rich faunal diversity and take remedial measures.

Mammals—Binturong, black buck, brow-antlered deer or thamin, caracal clouded leopard, desert cat, dungong, fishing cat, golden cat, golden langur, Himalayan thar, hispid hare, Indian lion, Indian wild ass, Indian wolf, red penda, lion-tailed macaque, loris, marble cat, mouse deer, musk deer, pigmy hog, one-horned rhinoceros, snow leopard, swamp deer, urial, wild buffalo and others.

Amphibians and reptiles—Gharial, mugger, salt-water crocodile, agra-monitor lizard, green sea turtle, hawk-bill turtle, salamander, Indian egg eating snake, leathery turtle, logger-head turtle, olive black logger head turtle, viviparous toad, water monitor and many other species.

Birds—Andaman teal, bengal florican, black-necked crain, blood pheasant, narcondom hornbill, nicobar megapode, micabar pigeon, monal pheasant, lammergeur, great Indian bustard, spotted owlet, jerdon's courser and other specie Crustacea—Robber crab.

Endemic animals

The endemic species are not safe as they are confined to a very restricted habitats with long range of distribution are comparatively safer. Many species which were once wide spread have now been driven to a very limited area owing to destruction of habitats.

Species now confined to small area—Marsh crocodile, gharial, One-horned rhinoceros, swamp deer black buck, The asiatic lion, Royal Bengal tiger, white winged wood duck, the mountain quail, the great Indian bustard, the bengal florican. the spotted owlet, the lion tailed macaque, red panda, the caracal, the Indian clouded leopard, the Indian tiger, the snow leopard, the one horned rhinoceros, the wild ass, the pigmy hog, the himalayan musk deer, the black buck, the wild buffalo, the gaur etc.

Endemic species—Narcondom hornbill, nicobar megapode, robber crab, Jerdon's courser, the nilgiri langur, brow antlered deer, the hispid hare, the markhor, the nilgai tahr, the wild yak etc.

National parks, wildlife sanctuaries and other reserves

India's vast wildlife resources have suffered a wide-scale annihilation during the period from 1940 to 1970. It redound to the credit of the foresters of India that they have been able to preserve most of its fauna from being extinct in her national parks and wildlife sanctuaries. But time has not yet come for complacency. In spite of several wildlife and game preservation acts having been passed outlawing indiscriminate killing of wildlife, national parks and wildlife sanctuaries have become the main refuge of wildlife.

India should feel satisfied, but not complacent, for having saved its wildlife in entirety including those threatened in its 47 zoological parks, 52 national parks and 223 wildlife sanctuaries covering an area of about 90000 sq. km. (figure up to 31.12.79). These parks and sanctuaries are distributed all over the country covering 110 climax types, 53 sub-types, 24 edaphic types, 22 seral types and 9 degraded types.

Conservation projects for endengered species like hangul (1970), lion (1972), tiger (1973), crocodile (1974) and brow antlered deer (1981) are sincere efforts to protect some threatened species.

The national parks have been set aside for the protection and conservation of outstanding natural and plant communities, for geological formations and for scenic beauties for the enjoyment of present and future generations in a manner consistent with scientific, cultural, educational and economic purposes. The wildlife sanctuaries have, however, been set aside for conservation and management of wildlife and the protection and management of habitats.

A bonanza of diverse ecosystems

India has been gifted with myriads of micro and macro eco-types, biotopes and complex of symbiotic plant-animal relationships in several ecosystems some of which are as under :

Aquatic and marsh ecosystem (representative sites)—Kolleru pelicanry, Nelapattu bird sanctuary, Nal-sar avar bird sanctuary (all in Andhra Pradesh), Sultanpur bird sanctuary (in Haryana), Chataprava and Ranganthitoo bird sanctuaries (in Karnataka), Ghana bird sanctuary (in Rajasthan), Valangudi (in Tamilnadu) and several others.

Estuarine ecosystem (special site)—These are an asset to this country life in Sunderbans (West Bengal) and Bhittar-kanica (Orissa). This ecosystem is the most complex of all ecosystems anywhere in the world.

Lagoon ecosystem—Chilks (Orissa), Point calemere (Tamilnadu) and Pulicat (Andhra Pradesh) sanctuaries are complex sites for micro and macro plants and animals. Aquatic flora which has become a rare commodity in this country will be saved in these sites.

Volcanic ecosystem—The Barren and Narcondom islands in the Andaman group are of volcanic origin. Narcondom hornbills are endemic to Narcon-dom island only. These are some feral goats in the Barren island. A thorough study of flora and fauna in these islands will reveal more interesting data.

Desert ecosystem—The Rajasthan desert sanctuary is a unique site for the conservation of desert flora and fauna.

Marine ecosystem—India has not established more than one which in the gulf of kutch. A sanctuary is to be established in Andaman at Chidiatappu.

Scores of marine animals and plants will be protected in these sanctuaries.

Marsh ecosystem—A grand assemblage of aquatic plants and insects and birds may be found in the sanctuaries at Pakhal, Pocharam, Dudhwa, Mahavira Harina Vanasthali, Kaziranga, Lakhawa, Orang and in several other such sanctuaries.

Tropical forest ecosystem—In the tropical forests of Andaman and Nicobar islands many endemic plants and animals occur. Megapode, nicobar pigeon, Andaman teal, Andaman pig have been given protection in South sentinel, Barren, Button islands and at Saddle peak and at Mount Harriet.

Sanctuaries in various geographical zones

According to Champion and Seth two major types of vegetation cover about 70% of the forest types of India ; these are—tropical moist deciduous (30.9%), tropical dry deciduous (38.7%). Other types are—tropical evergreen (6%), tropical and semi-evergreen (2.5%), littoral and swamp (0.9%), thorn forests (6.9%), montane wet temperate (2.1%), moist temperate (3.6%), dry temperate (0.3%), and others (8.4%). Of the distribution of parks and wildlife sanctuaries, the western ghat areas have 32, the western himalayas 33, the eastern ghats 15, Bhutan and Nepal 10, the eastern himalayas 15, the Mangrove sites 3, the Indogangetic plains and foot hills 25, dry deciduous and scrub forest areas 80 and the balance in other areas 20.

Rehabiliation of endangered species
(some major ones)

Crocodiles and gharial—At least 25 sanctuaries and parks offer protection to salt water crocodile, marsh crocodile and gharial. Massive breeding programmes have been undertaken to protect these reptiles. These may be seen at Manjira, Corinaga, Satkosia, Jawahar sagar, Krishna, Lanjamagadu, Chambal, Bhagabatpur, Nagarjun sagar, Guindy, Nandankanan, Katerniaghat, Amrawati Kinnersani, Manjira and at several other places.

One horned rhinoceros—This rare, animal is being given protection at Kaziranga, Manas, Sonai-Rupa, Orang, Lakhawa, Jaldapara (all in India) and at Chitwan-Rapty valley (in Nepal).

Tiger—In all the thirteen project tiger areas this animal is said to be breeding to expectation. Sunderban is a unique site.

Wild buffalo—This rare animal is receiving attention in Kaziranga, Manas, Lakhawa, Garampani, and at Kutru W. L. Sanctuaries.

Black buck—This rare animal is being given adequate protection in Taroba, Pocharam, Kewak, Bori Valavadar, Gir, Siriska, Ratapani, Panch, Kenawat, Kaimur, Tadwai, Nagarjun sagar, Tungabhadra, and Kanha national parks and sanctuaries.

Nilgai—This animal is being well lookedafter at Ranthambhore, Siriska, Yawal, Jaisamad, Nawagaon, Pochamarhi, Porch, Gir, Najira and Gomardha sanctuaries and national parks.

Florican—It has a very limited distribution probably in Orang in Assam.

Mouse deer—This animal is being given protection at Molem, Dalma, Borvili, and Simlipal wildlife sanctuaries.

Wild ass—The only sanctuary where it is getting protection is in Rann of Kutch.

Musk deer—This animal is getting protection at Dachigaon, Rajparian, Chimnai, Rohru, Tundah, Talsa, Kinnarnur and Rajgarh W. L. Sanctuaries.

Ibex, Bhoral and Markhor—At the sanctuaries at Rohru, Tunda, Kugli, Kelatop and Khajyor this animal is getting protection.

Swamp deer—At Kanha, Kaziranga, Dudwa Parks this animal has been safely breeding.

Flamingo—This bird is to be seen over a limited area in Chilka and Nalsaravar.

Pelican—This bird is to be seen at Chilka, Kolleru and Nelapattu W. L. Sanctuaries.

Hangul—This animal is to be seen only at Rajparian sanctuary in Kashmir.

Narcondom hornbill—It is to be seen only at Narcondom island sanctuary.

Robber crab—In the south sentinel island this crustacea can be seen.

Brow antlered deer—Keibul Lamjao National pak in Manipur is the only home of this deer.

Great Indian Bustard—This bird can only be seen at Bustard WLS in Maharastra, Desert WLS at Rajasthan, and at Ranebennur WLS at Karnataka.

Golden langur—Only to be seen at Manas WLS and to be west of the Sanctuary.

White tiger—It no longer can be found in forests.

Outstanding features of a few National parks and Sanctuaries

Of 222 wildlife sanctuaries and national parks of the sites have special features as (i) Wide coverage of latitudinal, longitudinal and altitudinal ranges, (ii) High density of animals species, (iii) High density of individual species, (iv) Rich floral species and (v) Diversities of sites—These qualities may be found in many parks sanctuaries, but some special sites are :

Kanchanjungha national park in Sikkim—It fulfils the above qualities (i), (iv) and (v). Snow leopard, clouded leopard, binturong, red panda, tibetan wild ass, blue sheep, takin, musk deer, marble cat and myriads of insects, butterflies and moths and birds are special feature of this sanctuary.

Namdhapa WLS in Arunachal Pradesh—It also fulfils the condition as the aforesaid one.

Corbett national park—It fulfils the aforesaid requisites (ii) (iii), (iv) and (v).

Simlipal Tiger reserve—It fulfils the qualities (iv) and (v).

Kanha national park—It fulfils the qualities (ii), (iii), (iv), and (v).

Nandadevi, Kadarnath and Valley of flowers sanctuaries—These fulfil requirements (i), (iv), and (v).

Sunderbans tiger reserve—It has the qualities (ii) to (v).

Kaziranga national park—It fulfils the requirements (ii) to (v).

Bandipur-Wynad-Nagarhole and Mudumalai WLS complex—Probably one of the best sites fulfilling all the conditions.

Abundance of chital in Palamau, Kanha, Corbett and Bandipur, Sambar at Ranthanbhore, Swamp deer at Kaziranga and Dudwa, Hog deer at Kaziranga, and wild buffalo at Kaziranga are some notable features.

Wildlife Research

Research in the field of wildlife is still in the incipient stage. The study of varieties of flora and fauna, their interaction symbiotic relationship, diseases, breeding etc. offer rare opportunities for research. Few countries in the world will be able to offer such diverse opportunities.

Decline in animal species and regression

During the last few centuries the vertebrate fauna has reduced considerably. Their composition was more complex. The intensity of this impoverishment is high. There has been qualitative and quantitative decline in the number of genera and individuals. Of species leading to a high degree of regression. The degree of such regression surpasses that of faunal impoverishment.

Mean faunal regression has been calculated by Dr. A. K. Mukherjee of ZSI in his paper entitled "Some examples of recent Faunal impoverishment and regression" (1974). He has found out that the rate of regression is 90%. He used the formula $\frac{(R-r)\times 100}{R} = Q$, where Q = coefficient of faunal regression ; R = size of the former distribution range in sq. km. ; r = present size in sq. km.

Why conservation programme ?

Flora and fauna are an integral part of the vast natural resources which are in perfect balance with each other. Efforts are being made to create vast areas of biosphere reserve primarily for the protection of the plant gene resources. The massive human population explosion and technological innovations have upset the balance. In the conservation of wildlife, air, water, soil, and living organisms are being conserved. Innumerable plant species are also being protected. The conservation has intrinsic cultural and scientific value. UNESCO'S 'Man and Biosphere' programme is concerned with these conservation problem and conservation education. In this country the population pressure and extension of agricultural land for optimal food production have overshadowed the conservation needs. Ecological principles have not received the attention as they should get, Indiscriminate hunting and food scarcity have intensified the capturing of animals, birds, snakes, lizards, frogs and even insects for the purpose of protein food.

Fish population and other aquatic life have been also depleted owing to shrinkage of aquatic sites. However it is well to mention here that the faunal wealth in the tropical and high humid temperature condition has been responsible for creating a very stable system in our country in which climate, soil, vegetation and fauna exist in an extremely complex state of dynamic equilibrium. Wildlife which is the faunal component of the ecosystem is closely associated with vegetation. But monoculture of economically important species tends to destroy the diversity of flora and fauna.

Lack of strong policy

There has not been a clear environmental policy in this country. Of late governmental and non-governmental agencies have been involved in the protection of environment. There has not been adequate public awareness of the importance of plant and animal life, of geological features scenic beauties bearing on our national life. People should be made aware of the utility of wildlife reserves which are not luxury but a crying necessity. The introduction of wildlife protection Act of 1972 has been a strong and useful step in this direction. Wildlife acts of 1873, 1878, 1932, 1933, and setting up of Indian Board of wildlife (1952) are also bold steps in conservation effort.

A great stride in conservation effort

Of late conservation has become an integral part of all development programme in this country. Ecological consideration are being given adequate attention while undertaking all developmental works. Clear guidelines have been formulated in this regard. All planning and executing agencies have been instructed to preserve all natural resources while developing it. A separate Department of Environment has been set up which controls all environmental problems including the wildlife wing of the forestry sector.

Efforts of the state governments to conserve and rehabilitate various species of wildlife in diverse sites have been commendable. Wildlife protection laws provide severe punishment for the law breaking and poachers. Yet the lure of the rhino horns as aphrodasiac, tiger, leopard and lizard skins for high commercial value, snakes, frog, turtle and birds of protein food has induced a large group of people to take poaching. As such the final battle of conservation of wildlife is yet to be won. The guiding philosophy of development should be 'development without destruction.' □

PLANNING FUTURE STARSHIPS IN SIBERIA

V. IVANOV*

Soviet scientists of the Siberian city of Krasnoyarsk are conducting a series of unique experiments on a device named BIO. These have very important bearing not only for future, super-long space voyages but also as a model for proper organisation of biosphere on the Earth.

CAN one go on a space mission lasting for many months without leaving the Earth ? Scientists of the Siberian city of Krasnoyarsk say they can.

A day before the Soviet-Indian space crew came back home from orbit a so far unprecedented experiment also ended here. Nikolai Bugreyev and Sergei Alexeyev, two young Soviet scientists, had spent five months in an airtight device called the Bios. Experts claim that such a period of time would be needed by a spaceship to reach the Mars from the Earth and cover a third of the distance on its way back.

Launching of the Experiment

The experiment was launched on November 11, 1983 at 14 hours Moscow time, as Nikolai and Sergei entered the Bios camera having a valume of 300 cubic metres. A thick metallic door was locked behind them and sealed, so that nobody could intrude and disturb the researchers isolated from the rest of the world. It was decided that the door would be opened only in case of emergency. The only things the two inhabitants of Bios were getting from the outside world were electricity and TV broadcasts. During the last few days spent in the camera they developed a keen interest in televised reports from outer space covering the Soviet-Indian joint mission. "Of course," Nikolai and Sergei admitted later, "we sort of envied the real cosmonauts, but we knew there were a lot of reasons for which they could envy us, too."

For many years now the staff of the Krasnoyarsk Institute of Biophysics of the USSR Academy of Sciences, Siberian branch, has been conducting research into problems pertaining to the Earth's biosphere. Some results have been very impressive and won the Institute international appreciation. Siberian scientists conduct a large amount of research to solve the problems related to long staying of man in outer space, that is in a closed habitat. The first researches on the above problems started here in 1961, right after Yuri Gagarin's first flight into outer space. Academician Sergei Korolyov, the chief designer of all Soviet space vehicles at that time, was always interested in the results of research. A long chain of experiments had resulted in the development of a rare apparatus named Bios meaning "life". While living inside the device for various time periods, scientists got the opportunity to learn to provide themselves with vegetable and grain foods and all other components required for a normal life.

Several varieties of wheat and vegetables are grown here on special plantations known as phytotrons. During the first few experiments, vegetable and grain foods made 30 to 40 per cent of the researchers' daily rations. In the last experiment ended on April 10 the share was doubled.

Based on substance Cycle

Commenting on the nature of the experiment, Joseph Gitelzon, Alternate Member of the USSR Academy of Sciences in charge of the project, said : "Our work is based on the principle of substance cycle in Nature, the chief mechanism that enables man to live on the Earth. Our experiments are fundamental and directly related to space flights. But we do not focus on prolonged space flights over large distance alone. Our experiments have a general biological implication, which has helped us arrive at a sad conclusion that life

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on the Earth has not yet been organised properly. There are yet a lot of tensions, in some parts they result from overpopulation, in others —from bad crops, etc. Meanwhile, Nature alone is not to be blamed for that. It appears extremely important to us to learn to use the Nature whose potential is virtually unlimited. For example, in the Bios we can reap in up to six harvests of wheat per year. Yet this is by far not the only thing that Bios can help us do. Our methods for fast growing of grain and vegetable crops are being used by the leading selectionists of the country for developing new varieties. One should realise that mankind is facing the task of thoroughly studying the substance cycle and learning to control it."

Nikolai Bugreyev, for one, has spent altogether 13 months in isolation, including the Bios experiment. Cheerful and energetic, he talks willingly about his impressions and compares his previous experiments with the one that has just been over. During the previous experiments in Bios, the researchers had 13 square metres of arable land per head. In the last experiment the space was doubled. As yields went up, daily rations improved to include new products, such as peas and turnip-rooted cabbage.

"It's the first time I have been involved in such an experiment," said Sergei Alexeyev. "I hardly noticed how time passed. We had a lot of interesting work to do, so we did not use simulators as a cure against hypodynamy. We did not have them at all. We just worked. Apart from medical examinations of ourselves, we had to take care about plants, reap in harvests, bake bread, cook various dishes of plants and products that we had taken along. We were also writing diaries and reading much. Sometimes we were allowed to talk with our relatives. Although we were constantly watched by physicians, their interference was not necessary. Both of us revealed a good psychological compatibility and an ideal health."

Nikolai and Sergei invited this correspondent to enter the Bios. The first thing I felt when I came in was the fresh air full of ozone blowing in a light breeze. It was as if I was walking across a field on a fine summer day just after rain. In the dwelling premises there are two well-appointed single compartments, a kitchen-cum-dining room and an armchair. Siberian scientists are of the opinion that future starship will be fitted out in a similar way to lessen psychological tensions of the crew and enable them to endure a long separation from the Earth. ☐

THE WORLD PREPARES TO MEET HALLEY'S COMET

B. B. BALIGA*

SINCE the last several years, man, the world over, is preparing to meet and probe Halley's comet which is coming very close to the Earth in 1985-86. The scientific community all over the world is united in this common purpose and hopes to understand more about such objects which stray into our solar system. The origin of these is still unknown.

Comet Halley was last seen in the sky in 1910 and it comes every 76 years, quite close to the Earth. Man has made much progress in these 76 years, both in science and technology. Thus the preparations are rather elaborate. The Soviet Union will launch on December 15, 1984, the first of the space probes to intercept Halley's comet in March 1986. The first Soviet Space craft Vega-I will be followed six days later by an identical spacecraft Vega-II. Japan plans to launch two identical space probes on January 5th and August 14th, 1985. The European Space Agency's Comet Halley probe—Giotto will go up on July 2, 1985.

The Soviet Union is launcing its probes a bit early because they will pass Venus on their way to the comet. Originally these probes were intended to probe planet Venus and were similar to the long line of successful Soviet probes to that planet. Remember the Venus-13 and 14 crafts that took the first colour photographs of the planet surface, back in 1982 and Venus-15 and 16 crafts that have been orbiting around Venus for over a year now ?

Originally aimed to explore Venus, the Soviet astronomers realised that the main space craft after passing Venus would come to Halley's comet, after it had circled the Sun one and a half times. The scientists, therefore, altered the mission to include both Venus and Halley's comet (the name Vega is a contraction of Venus-Halley : the letter H transliterates into Russian as an aspirant 'G'). This Rs. 140 crores pair of Vega probes mission involve many of the European countries besides the Soviet Union. They are Hungary, Poland, Czechoslovakia, Bulgaria, East Germany, Austria, France and West Germany.

The two crafts are scheduled to be launched on the Soviet Proton rockets in this month and will reach Venus on 14th and 15th June next year. As the main probes pass the planet they will drop a lander craft which will release a balloon as it descends into the thick clouds of Venus. The balloon, which is expected to survive about two days, will provide new data on the hot and dense atmosphere. The landing craft itself will descend by a parachute from a height of 60 km, taking measurements of the atmosphere on the way down. On reaching the ground it will investigate the composition of the surface by irradiating it with x-rays and gamma-rays (activation analysis of the soil). One may recall that the American Pioneer probe had indicated that Venus had active volcanoes and the Vega results are expected to increase our understanding of volcanism of Venus by correlating the surface composition analysis with topography revealed by radar.

The present craft which will pass Venus at a distance of 30,000 km, will use the planet's gravitational field to pull them into a new orbit, which will take them beyond the orbit of the Earth before meeting comet Halley in March 1986. As Vega-I will be the first probe to reach the comet, Soviets have agreed to release the data that it gathers immediately to other countries involved in Halley's mission. This is especially important to the European scientists whose probe Giotto will be aimed at the nucleus of the comet, which is hardly a few kilometers across and it is not possible for the telescopes on the Earth to see it directly. The information on Vega-I which will pass the comet at a distance of 10,000 km, will allow

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European scientists to redirect Giotto to within 100 km of the nucleus, the final correction to be made in the orbit just two days prior to its encounter with the comet.

Each Vega craft which will fly-past at a relative speed of 78 km/sec, is sturdily built to withstand the impact of particles of dust in the comet's gaseous head. The rather large solar panels are capable of providing power for all the instruments during the probe's rapid fly-past. The camera platform of the crafts can swivel to watch the comet in its flight. Besides several instruments on the craft will investigate the comet's dust and gas. A novel dust counter will record the amount of dust simply by hearing the impact of dust particles on a special plate. Another instrument will measure the composition of the plasma which results when the high speed impact vapourises the dust. The Vega crafts are also equipped with instruments to measure the comet's magnetic fields, low frequency radio waves generated in the field and the composition of the comet's gases.

Some more details about the instruments on board these two crafts is available. Mounted on the camera platform are a pair of identical telescopes each with a mirror 14 cm across, which will feed radiation to two complementary instruments. One of them will look at the spectrum and at the polarisation of light from the comet's nucleus which will enable to study the light reflectivity from the dust particles and to measure the speed of emission of various gases from the nucleus. The second telescope will focus the radiation on to an infra-red detector and allow the astronomers to estimate the temperature of the comet's nucleus, the dust streaming away from it and may provide information on some of the molecules emitted by the nucleus.

The two cameras on each platform will send back the first ever close-up images of a comet's nucleus. The wide field camera sees a region about 4° across ; this is about eight times the apparent size of the Moon seen from the Earth. The pictures are expected to give a good view of the comet's gaseous head (also called coma) and it will reveal the position of the nucleus in the head. This camera's view will then guide the platform so that the narrow field camera with a view only of 0.5° across, can look directly at the nucleus ; this camera should see details as small as 200 m across on the surface of the nucleus. As the camera is equipped with different filters, it will be possible for the astronomers to combine the various images and construct a unified colour picture of the centre of the comet.

The analysis of the data from the first craft will be utilised by the Soviet scientists to swing Vega-II closer to see finer details in the nucleus. If Vega-I finds little problem with impacts from dust at a distance of 10,000 km it will be possible to manoeuvre Vega-II to within 3000 km, which will enable it to resolve details in the cold nucleus only about 70 km across.

The day before Vega-II's encounter with the comet, two Japanese crafts will be simultaneously probing the comet from a considerably longer distance. Like the Soviet ones the two crafts Japan plans to send are externally similar : each weighs 150 kg and will spin once every 12 seconds in space. The first one to be launched on January 4, 1985 is MS-T5 which is mainly to test their rocket—the M-3S2—the probe's own small rocket, its communication systems to control the probe's attitude. The experience gained will be fed in preparing the second launching with the probe—Planet-A in August 1985. However, both will have its rendezvous with comet Halley on the same day in 1986. Since a single probe will not be able to carry all the equipments that the Japanese scientists want to use in studying the comet, the MS-T5 will carry a magnetometer, a low frequency receiver to investigate radio waves in the surrounding plasmas, and a detector to study the solar wind. The MS-T5 will approach just about 4 million kilometers to the comet and will investigate how the solar wind down stream of the comet is perturbed by the presence of Halley's comet. It will be possible to compare data collected with that obtained at the end of March 1986 from NASA's international comet Explorer that is expected to pass 30 million km downstream of Halley's comet. The Planet-A probe will carry a more sophisticated vacuum ultra-violet camera and will pass much closer (200,000 km) from the sun-facing side of the comet. It will take ultra-violet pictures of the nucleus of the comet. The plasma energy spectrum analyser will measure the three dimensional distribution of ions and electrons of the solar wind as well as those emitted from the coma of the comet.

European Space Agency is sending its own mission Giotto which is expected to fly right into the comet's centre. However, as stated earlier, in-orbit manoeuvring will be necessary with proper feed-back data from Vega-I. If everything goes on well Giotto may reach within 100 km of the nucleus and transmit a lot of information about the nucleus for the first time. The astronomers are confident to collect a lot of information from this time's apparition as all the missions, though from different countries and groups, are complementary rather than competitive. The cooperation and coordination which is good so far is expected to continue till the end.

Edmund Halley, after whom the comet is named, might never have thought in his wildest fancies that the bright object that he observed in 1682 would bring him fame over the centuries. Its appearance every 76 years just renews this memory. However, with its determined regularity and checking with the available astronomical records, this has been traced back to as early as 66 A.D. It should be noted that these were all naked eye observational records.

The highly elliptical path of comet Halley around the Sun carries it well beyond Neptune's orbit to just within Venus'. The comet's orbital plane is inclined 18° to the Earth's and its motion is retrograde (in the opposite direction from the planets). Thus Halley's orbit lies near our own for an extended interval before and after perihelion (the comet's closest approach to the Sun). In more than a third of its apparition in the past 2000 years, comet Halley passed within 0.2 astronomical units (about 30 million km) of the Earth. This is the reason why the visitor had been so well documented throughout all the history.

On the basis of the geometrical circumstances of past Halley apparitions, experts on comets divide the encounters into three broad catagories : Type I : The comet comes closest to the Earth on the inbound leg of its orbit several weeks before perihelion. It first becomes visible as a slowly brightening object in the morning sky far removed .from the Sun. At such returns the comet lies at far northern declination and is very well placed for observation from the Earth's northern hemisphere. Following the comet's closest approach, it moves into the Sun's glare where it typically remains until has faded well beyond the naked-eye threshold. Type II : Closest approach to Earth occurs within a few weeks of perihelion. In this case Halley usually appears rather suddenly in the morning sky bright and fully developed. It then falls back rapidly towards the Sun and reaches conjunction well north of it. Becoming an evening object, it quickly attains maximum eastern elongation. As the comet fades it all descends into the evening twilight and is lost. Type III : Halley passes closest to the Earth some weeks after perihelion. At first it is on opposite side of the Sun as seen from the Earth, and its approach is hidden from view. No naked-eye observations are possible until a week or two following perihelion passage. Then suddenly Halley rises out of the morning twilight, bright and sporting a long tail. The comet's track across the heavens strongly depends on whether closest approach occurs inside or outside the Earth's orbit. In the first case the comet will return to conjunction with the Sun and will reappear as an evening object. In the second case it will drift from the morning sky and into the evening sky.

Either kind of type III apparitions is far more spectacular than type I or II. Approaching the Earth the comet becomes brilliant. Its huge dust tail, subdued before perihelion, stretches scores of degrees across the sky. Unfortunately the type III appearances occur in the springtime in the northern hemisphere, where twilight often can be a serious hindrance.

The current apparition of comet Halley is unique ; it closely resembles type III, but does not fit neatly into any of the three types. With the perihelion occurring on the far side of the Sun, the 1985-86 apparition will result in two moderately favourable passages by the Earth instead of only one. The first on the comet's inbound leg will favour the northern hemisphere observers. The second with the comet's outbound and somewhat closer to the Earth, will be a southern hemisphere event.

What do we know about comets ? We know that the cometary activity is transient. It gets bigger, brighter and develops tail as it approaches the Sun. It is at its full glory when it is closest to the Sun. It fades as it recedes from the Sun. The material in the tail of the comet must come from the core of the comet which is called the nucleus.

It is believed that the nucleus of the comet consists mostly of frozen gases, such as H, C, N, and O and frozen water molecules mixed with dust (silicate particles). The solar heating liberates the frozen gases and dust which expands outwards in spherical form (called coma) and extends upto 10^5 km. The dust particles in this cloud reflects solar radiation and makes it visible. Surrounding the coma is a halo of hydrogen gas extending upto 10^7 km. Ultra-violet sensitive instruments can easily spot it. Solar radiation which exerts pressure on the dust particles pushes them away from the Sun which gives rise to a tail. Solar radiation is also responsible for breaking the original molecules released by the nucleus and ionises them. These charged particles are swept out of the solar wind (stream of charged particles coming out of the Sun) and a second tail called plasma tail is formed. The characteristic light emitted by the ionised gases makes visible the plasma tail which extends upto 10^7 km. Thus every time a comet enters the solar system the nucleus looses material which is finally dispersed into the solar system.

The origins of the comets is not fully understood. However, the spectroscopic data supports the hypothesis of solar origin. It is believed that they were formed at the same time as the Sun and the planets. Thus studying the material of the nucleus of the comet it may give a clue to the original solar nuclear material. There are other questions too to answer, especially about the spin. It is hoped that in the 1985-86 apparition many of these questions will be answered as the direct probe can go quite close to the nucleus of the comet.

It should be remembered that during the 1910 apparition of the comet Halley the British scientist, Evershed had taken a number of photographs of the comet from the Indian soil at the Kodaikanal observatory. These valuable photographs are still used as a guide for the comet's imminent apparition. Besides, several volumes of data collected at that time are presently available at the Hyderabad observatory.

In July of this year a two days workshop on 'Observing of Comet Halley' held at the Indian Institute of Astrophysics, Bangalore coordinated the Indian efforts. The scientists directly involved in the observation of the comet met and discussed their research and explored the possibility of cooperative programme. The forty odd participants came from various institutes, observatories and universities. Studies will be carried out by the three major observatories in India, namely the Indian Institute of Astrophysics in Bangalore, Osmania University in Hyderabad and the Utter Pradesh State Observatory at Nainital. These will be supplemented by the observations carried out at the Punjab University in Patiala and the Positional Astronomy Centre in Calcutta. The three observatories mentioned earlier will also make available the data about the position of the comet (measured by photographing it at regular intervals) to the scientists in the USSR and in exchange will get the scientific information on the comet collected by the two space probes.

India will also collaborate in the International Halley Watch (IHW) set up by the National Aeronautics and Space Administration (NASA), USA, for coordinating the various obsevations. This worldwide network of observatories is to make observations to cover the entire orbit of the comet as it approaches and recedes from the Sun. Indian observatories will be critical in this link as there are no other observatories in this region. The membership of IHW (professional and amateurs) has risen from 875 to 1295 in 47 countries. Thus IHW will be a focal point for exchange of information, discussion of common problem and mutual support to enhance the overall scientific returns from various space missions to the Halley's comet. It is in fact, the global effort to explain Halley's comet as completely as possible during its present apparition. ☐

RADHA GOBINDA CHANDRA—AN ASTRONOMER, UNRECOGNISED IN HIS OWN COUNTRY

RANATOSH CHAKRABORTI*

IT is strange to think that a petty clerk of a Govt. Office every day after his day's hard toil is observing the stars and planets of the night sky. But it is true in the case of Radha Gobinda Chandra, originally a podder (coin tester) of a collectorate office whose astronomical observations were once widely appreciated by the astronomers of Europe and America.

Radha Gobinda Chandra was born in 1878 at Bagchar of Jessore, now in Bangladesh. He was brought up in his maternal uncle's house. His academic career was short and simple. He did neither acquire any university degree, nor go to any college. Surprisingly, he did not even pass the Entrance Examination. At the age of 21 he joined the district collectorate of Jessore as a podder with a monthly salary of rupees fifteen only.

Although he had shown nothing bright in his early academic career, Radha Gobinda was a serious reader at home. He utilized fully the academic atmosphere of his maternal house. In his boyhood he read a book—"Brahmanda Ki Prakanda" (How vast is the Universe) edited by Akshoy Kumar Dutta, which made Radha Gobinda to take a keen interest in the sky. Moreover, Kalinath Mukhopadhya, a pleader of Jessore and an amateur astronomer drew him nearer to astronomy. Consequently, Radha Gobinda, with the help of a simple binocular and naked eye started to observe the celestial bodies. Meanwhile, in 1910 Halley's comet appeared. Radha Gobinda took the opportunity, and he published two articles in Bengali about the comet in a magazine "Hindu". At that time he came into contact with Jagadananda Roy of Santiniketan, who suggested that he should collect a telescope. Radha Gobinda purchased a three inch refractor telescope from London at the cost of Rs. 257 and 6 paisa. Now, with great enthusiasm he started his astronomical observations and came in touch with the astronomers of Europe and America.

His life-long researches were wide spread in various astronomical phenomena, like variable stars, occultation of stars, nova, meteors, eclipses and so on. But most of his contributions to foreign journals were on variable stars. His outstanding contributions in the field of variable stars helped to a great extent in the classification of variable stars. Adequate reference of which are in the abstracts of Astronomy and Astrophysics and also in the books and journals.

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Radha Gobinda was the first, not only in India but in Asia, to observe a new star on June 7 of 1918 in Aquila constellation.

From the remnants of his old records, it appears that astronomers of Western countries attached great importance to the observations made by Radha Gobinda. One of the letters written from Harvard College Observatory on January 17, 1920 states—"The observations which you contributed are very good and we hope you will continue to send them each month" Similarly, the secretary, AAVSO (American Association of Variable Stars Observers) on May 29, 1920 wrote to Radha Gobinda : "Thank you very much for the splendid list of observations of variable stars, which you have been sending to the AAVSO". A letter from British Astronomical Association dated the 27th Dec. 1923 states—"Your excellent observations and remarks are always much valued by this section, and I hope we may continue to enjoy your hearty and enthusiastic support". Besides this, Harvard Observatory published his photograph in their publication which can still be seen at his last residence at Barasat, near Calcutta. Moreover, to help him in his observations, Harvard Observatory presented him with a 6¼" reflector telescope in the year 1926 which was sent to Bagchar, all the way from America. Soon afterwards, the Education Department of France honoured Radha Gobinda Chandra by confering on him the honourable title of "Officer d' Academic Republique Francaise". The title and a medal were forwarded to Radha Gobinda by the Consulate General of France at Calcutta on 1st August 1928. In recognition of the merit of his scientific observations, British Astronomical Association, Harvard College Observatory; Lyon Observatory, France ; American Meteor Society ; American Museum of Natural History, offered him membership, and he accepted their offer. In 1950, 12th Dec. the Harvard Observatory wrote a letter of appreciation to Radha Gobinda, a part of which is mentioned here : "The American Association of Variable Stars Observers, with headquarter at the Harvard Observatory is honoured to salute you as one of its important contributors from abroad."

At the fag end of his life when Radha Gobinda could no longer take observations, he approached individuals and organisation to be the custodian of his telescope mentioned earlier. At the instance of the Harvard Observatory, the telescope was ultimately handed over to late Dr. V. Bappu, the then Director of the Indian Institute of Astrophysics, Bangalore. It is however, not known whether the telescope which contributed so much in the observation of variable stars through the meticulous efforts of Radha Gobinda in the past is still in operation in one of our Indian Observatories.

Apart from all these, Radha Gobinda should also be remembered in our country for his outstanding contributions to the Calendar reformation movement, on which he published some valuable articles. He was actively associated with this movement, but detailed history of his contribution is not available.

He wrote some popular books on Astronomy but only one of them on comets ("Dhumketu" in Bengali) was published and perhaps is one of the authentic books on the subject—the rest are till in manuscript form and deserve consideration for publication.

Radha Gobinda is no longer with us. He died at the age of 97 on 3rd April, 1975. It is unfortunate that no serious attempt has so far been made to explore the complete works of Radha Gobinda Chandra. Although his life should serve as a beacon light to every serious voyager in the domain of science and knowledge. ☐

Nobel Prizes : 1984

PHYSICS

Nobel prize for 1984 in Physics has been awarded to Carlo Rubbia and Simon van der Meer jointly, both from the CERN for their decisive contributions to the large project which led to the discovery of the field particles W and Z, communicators of the weak interaction.

They, by their discovery, confirmed the unification of electromagnetism and the weak nuclear force. The formulation of the theory of weak force before 50 years by Fermi opened a new era in nuclear physics. Attempts to unify weak force with the electromagnetism theoretically are recent and the electroweak picture formulated by Sheldon Glashow, Abdus Salam, Steven Weinberg through the gauge theory earned the Nobel award in Physics for them in 1979. The theory predicted the existence of the particles $W^{\pm}$ and Z^{0} of masses 83.0 ± 2.9 Gev and 93.8 ± 2.5 Gev respectively. To find these particles is not a trivial task, since it would require a very high energy accelerator, not existing in any laboratory. It was not very strange when a renowned experimentalist remarked on the award of 1979 Nobel award that 'Are they going to give back the prize, if these particles are not found ?'

Thanks to the proton-antiproton collider at CERN which produced these particles in 1983.

Rubbia was the driving force of the experiment at CERN. In 1976, he proposed the Fermilab authorities in USA to modify their accelerators to proton-antiproton collider. The proposal was faced some disfavour. At CERN, the idea was favoured by the then Research Director-General Leon Van Hove and the Executive Director-General Sir John Adams. During 1976-80, the term of their office, they had the crucial roles in pushing the Antiproton project at CERN.

The concept of colliding beam to avoid the knock on energy loss by head on collision into one another is a bold step for energy increase in accelerator technology. Electron-positron colliding beams with the same magnet in Orsay by Bruno Touschek and at Stanford by Richter were the pioneer experiments in this direction. The team led by Kjell Johnson at CERN built the Intersecting storage rings (ISR) for two proton beams. From the positron-electron collider experiment, it was obvious to apply the technique for proton-antiproton collision in the same magnet ring in which particles circulate in mutally opposite direction. But the difficulties in producing intense antiproton beam make the experiment nearly impossible. The invention of stochastic beam cooling by Simon van der Meer made it possible for such intensification of antiprotons. In 1972, his first report on this technique applied to ISR was published in which he presented some quantitative estimation of the effect based on his observation. In a final test in, 1974, carried out in the ISR, it was enough to show that the idea of beam cooling, i.e. the reduction of the spread of particle energies around a desired value had succeeded. During 1976-77, a storage ring at CERN was converted to test the cooling technique and was renamed ICE—Initial cooling Experiment. The rasults of the experiment obtained in 1977-78 were encouraging. Meer was responsible for inventing and applying the technique to the CERN super-proton synchrotron successfully to obtain an intense antiproton beam, which was the key to the experiment leading to the discovery of W and Z.

Carlo Rubbia was the driving force who conceived the experiment and its over-all scenario in 1976. He was responsible for conducting a large team consisting of hundreds of people involved in the CERN super-proton synchroton experiment leading to the discovery of W and Z. The team consisted of 130 physicists from 13 research centres—Aachen, Annecy LAPP, Birmingham, CERN, Helsinki, Queen Mary College, London; College de France, Paris; Riverside, Rome, Rutherford, Saclay, Vienna and Wisconsin. Use of the 270 Gev proton collider to produce 540 Gev energy by proton antiproton collision and carrying the collision experiment in UAI code named after underground area in the excavated large cavern, was the responsibility of Rubbia. The Antiproton accumulator (AA), a storage ring for producing stochastic cooling for intense antiproton beam devised by Meer, was soon constructed by Roy Billinge and his team. In 1978, another collision region UA2 was approved in collaboration with fifty physicists from Bern, CERN, Copenhagen, Orsay, Pavia and Saclay led by Pierre Darriulate.

In February 1981, the proton synchrotron at CERN accelerated antiprotons from the AA. At a Topical Workshop on proton Antiproton collider physics' held in Rome from 12-14 January 1983, evidence for observation of W particles by UA1 and UA2 collaborations was announced. A few signals out of several thousand million proton antiproton collisions corresponded to the W particles decaying into an electron (or positron for W^+) and a neutrino. On January 20, Rubbia reported six W events in UA1 and Luigi Di Lella reported four such events in UA2 tentatively. Rubbia was more convinced to comment "They look like W's, they feel like W's, they smell like W's, they must be W's". On January 25, 1983, they reported their discovery in a press conference with an estimate of mass about 80 Gev in excellent agreement predicted by the electroweak theory. The theory predicted the production rate of Z lower than W by nearly ten times. So the physicists had to push the collision rates higher to detect the decay product electron-positron pair or muon pair of Z. Success was achieved in no time and the discovery of Z was announced on June 1, 1983 with its estimated mass nearly 90 Gev in line with the theoretical prediction.

By the discovery of W and Z particles, which are bosons in character, man arrived in his quest to a crucial point to understand the universe. It is a step forward to the still undiscovered Grand Unification Theory, which assumes unification of the four forces namely gravitation, nuclear, weak and electromagnetism in the moment of bigbang creation of the universe.

The discovery of W and Z is ranked among the greatest achievements in the history of science. It has been made possible by high technological excellence and a team work unparalleled in the area of pure research.

All the credits of the discovery go to Meer and Rubbia for which they are recognised with the Nobel Award for 1984 in Physics. Rubbia is 50 and is a professor in the Harvard University along with his responsibilities in the CERN laboratory. He was born in Garcia in Italy. His father was an Electrical Engineer. Rubbia had hobby for electronics in his boyhood, which helped him in his scientific career.

Meer was born in 1925 in Hague, educated in Engineering in Delft. He worked in the Phillips Company in Eindoven for sometime in electron microscopy. Since 1956, he is in CERN and has specialised in accelerator Physics. ☐

S. B. Karmohapatro

CHEMISTRY

Prof. Robert Bruce Merrifield of Rockfeller University, New York City, U.S.A., has been awarded the 1984 Nobel Prize for Chemistry. The Prize Committee in their citation have stated that Prof. Merrifield has been honoured for his outstanding contributions in the fields of solid phase chemical synthesis.

Merrifield started this work in the early sixties with regard to the synthesis of peptides. But long before Merrifield, scientists had tried to synthesize proteins in the laboratory. The steps they followed were: (i) protection of amino acid carboxyl group, (ii) formation of peptide bond, (iii) selective removal of the amino terminal protecting group, (iv) elongation of the peptide chain by repeating steps (ii) and (iii); and finally (v) removal of all protecting groups. This strategy is known as stepwise elongation.

Peptides, as we know, are amino acids linked by chemical condensation of the amino group and the carboxyl group. In a liquid phase synthesis of these peptides is started with the initial amino acid with its amino terminal group protected. Then the second amino acid with its group protected is added and reacted with the first one under special conditions. This mixture, now contains the dipeptide and the unreacted amino acids. The dipeptide in the next step has to be isolated from this mixture, before it is used as the starting material for the tripeptide stage. Thus, it is seen that this type of synthesis would involve many difficult steps of isolation and reaction to synthesize a large peptide. The loss of material in each step would accumulate significantly. Till 1963 all these reactions had to be carried out in appropriate solvents and the products at each stage had to be purified by crystallisation.

In 1963 Merrifield introduced a new concept in the synthesis of peptides known as "Solid phase peptide synthesis". He suggested that the first amino acid be chemically bonded to a polymer and the peptide synthesis be carried out using the polymer support. In the early experiment, sytrene polymer beads with chloromethyl groups as cross linking groups, were used. The first amino acid (actually the terminal amino acid of the proposed peptide chain) was attached by its carboxyl group to the reactive site. The second amino acid with all but one of its reactive groups protected was activited and coupled to the first amino acid, leaving the protected dipeptide firmly bound to the support. When the desired peptide has been synthesised, it is liberated from the solid support. The solid could be filtered and washed thoroughly in each step. An automated process at the press of a button or control valve could remove all the excess reagents and any byproducts without the slightest loss of the desired peptide.

In 1963 insulin, a small protein with two peptide chains of 21 and 30 amino acids was synthesized in Germany, USA and China. In 1965, the same protein was synthesized in Merrifield's laboratory using automated solid phase peptide synthesizer.

Several peptides and nucleic acids have been synthesized using this method. It is to be hopped that molecules related to insulin would be prepared in the near future which may exhibit greater activity for the treatment of diabetes. It may also be possible that more efficient synthetic enzymes may be found.

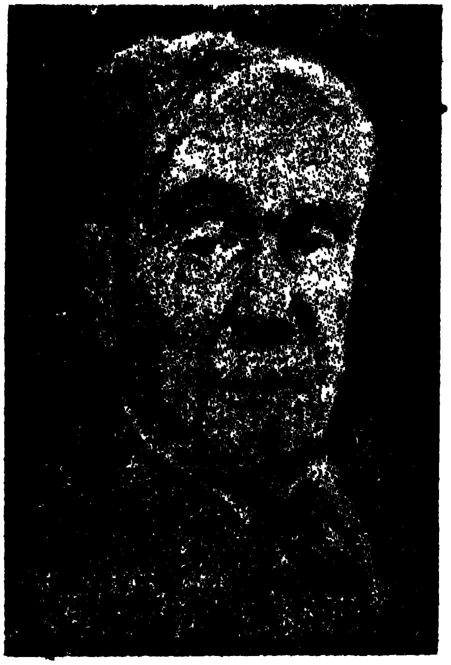
Merrifield was born on July 15, 1921 at Fortworth, Texas. He got his Ph.D. from California University, Los Angels. He is very fond of gardening. When he was told of his Nobel Prize award, he remarked 'I can now spend the rest of my life in gardening'. ☐

RabinBanerjee

OBITUARY

PJOTR LEON IDOVICH KAPITZA

With the death of the renowned Soviet Physicist Peter L. Kapitza on April 8, 1984 the world of science lost its one of the great exponents and thus has suffered a severe loss.



Pjotr Leon Idovich Kapitza

Kapitza was born on July 9, 1894 in Kronstadt in Russia. His father was a military engineer and his mother worked in higher educations and folklore research. Kapitza graduated from the Petrograd Polytechnical Institute in 1918 and was a Lecturer there till 1921. There he began his scientific career in Joffe's section of the electromechanics department by proposing a method jointly with N.N. Semenov, for determining the magnetic moment of an atom interacting with an inhomogeneous magnetic field. The method was the basis of the celebrated stern-Gerlach experiments in a later period.

In 1921, Kapitza joined the Cavendish laboratory at Cambridge University to work with E. Rutherford. There is a story about his admission to the group of students of Rutherford. At the first instance when Rutherford refused to accept him, he asked how accurate Rutherford's measurements were. The answer was that they were accurate to about 3%. Then Kapitza's arguments were that by admitting one more student, the charge of his total number of research students will be less than the margin of his error in measurements. Rutherford had, at that time, a galaxy of a large number of Researchers under him. With such witty argument of Kapitza, Rutherford is said not to hesitate any more to include him in his laboratory. Another story goes like this that Kapitza was in a contingent of Russian Scientists visiting Europe, when he came to Cambridge to buy a precision galvanometer. There he met Rutherford who was so impressed with his ideas that he offered him a place in the Cavendish Laboratory. Rutherford had ability of quick grasp of genius of a person in a first contact, through which on a similar occasion he could recognise Niels Bohr in 1921 and offered him a Readership in Manchester.

In 1923, Kapitza made here his experiment to observe the bending of alpha particles in a cloud chamber placed in a strong magnetic field. In 1924, he devised method for producing very strong magnetic field and produced field up to 320 Kilogauss (32 Tesla) in a 2 ml volume. In 1928, he discovered that metals placed in a strong magnetic field have varying resistance depending linearly on the variation of the magneticfield. In 1923, he received his Ph. D. from Cambridge. Later on, he became Director of the Royal Society Mond Laboratory at Cambridge and a Fellow of the Royal Society.

In his last years in Cambridge, Kapitza turned to low temperature physics research. In 1934, he developed an apparatus for liquifying Helium based on the adiabatic principle. The same year Kapitza returned to Moscow for a short visit, but was not permitted to leave again until 1965. At this stage, Rutherford published a letter in the *Times of London* on April 29, 1935 urging the Soviet Government to permit Kapitza to work in Cambridge to enable him to choose the environment in which he can most effectively utilise the special creative gift with which he is endowed. Rutherford concluded the letter thus. 'It would be a tragedy if these gift were rendered sterile by failure to grasp the psychological situation'. The full text of the letter was reprinted in *Science and Culture* in June, 1935 (p. 44) with an editorial note supporting Rutherford and appealing to the Soviet Government, on behalf of the Indian scientists, to allow Prof. Kapitza to come to Cambridge and continue his researches there.

Perhaps the appeals were effective to some extent. Though Kapitza was not allowed to come to Cambridge, even then his equipments in the Cambridge Mond Laboratory were purchased at cost by the Soviet Government for an institute created for Kapitza in Moscow. In Moscow, with these equipments, he organised a new research institute, namely Institute for Physical problems, where his main lines of research were low-temperature physics and strong magnetic field. He was there active till 1946 when he is said to have acquired some disfavour of Stalin and was kept as a home detenu until Stalin's death in 1954. Again, he resumed his affiliation with the institute for physical problems.

In 1920's HeII was invented. In 1932, Keesom and Clusius at the Leiden Laboratory found an anomaly in the specific heat of Helium known as the lambda point. Three years later, Keesom and his daughter observed the extremely high thermal conductivity of HeII. The year 1938 volume of *Nature* published nearly 141 theoretical and experimental papers on HeII which was very unusual. This indicated how intense was the interest of the Scientific community on this fluid. Kapitza in Moscow, Allen and Misener in Cambridge, independently published the same year in *Nature* reports on the negligibility of the viscosity on HeII. Kapitza mentioned that HeII has the viscosity 10,000 times less than gaseous hydrogen, the least viscous fluid known at that time. Kapitza called Helium below the lamda point to have a special state or it is superfluid. The discovery of fountain effect in HeII by Allen and Harry Jones was based on the findings of Kapitza, Allen and Meisener.

Fritz London suggested that the superfluidity of HeII could be explained in terms of Bose-Einstein condensation as it is in a macroscopic quantum state. Kapitza experimented on the properties of HeII indicating it as a quantum fluid with zero entropy. In a series of brilliant experiments, Kapitza proved that in HeII, a new kind of internal convection occurs in which a normal fluid transport the heat and a simultaneous superfluid flow takes place in the opposite direction. Later, he discovered microwave generator of high power and a new type of continuous high pressure plasma discharge with ~ 10^6 K electron temperature, an indication of a thermonuclear energy generator.

In 1938, while Kapitza was studying HeII through his novel experiments, Landau, a renowned Soviet theoretician, had been in jail. Kapitza could convince Stalin to release Landau and Landau, when freed developed the theory of liquid Helium recognised by 1962 Nobel prize.

It was a surprise to the world of science that Kapitza had to wait till his old age to be recognised by 1978 Nobel Prize. In the award, the Nobel Committee cited that Kapitza discovered ideas and new techniques that have been basic to the modern expansion of the science of low-temperature physics.

Kapitza was a Clerk Maxwell student of Cambridge University during 1923-26, Assistant Director of Magnetic Research at Cavendish Laboratory (1924-32), Messel Research Professor of the Royal Society in 1930-34 and Director of the Mond Laboratory during the same period. In 1935, he became the Director of the Institute of Physical Problems.

In 1957, he was elected a member of the presidium of the USSR Academy of Sciences. He was one of the founders of the Moscow Physics Technical Institute and was head of the low-temperature physics department in that institute.

He was the editor-in-chief of the *Journal of Experimental and Theoretical Physics* and was a member of National Committee of the Pugwash movement of scientists for peace and disarmament.

Kapitza received eleven honorary degrees and was elected to membership of numerous academies which include USSR Academy of Science, the Royal Society of London (1929), the Royal Danish Academy of Sciences and letters, the U.S. National Academy of Sciences, the Royal Netherland Academy of Sciences and the Indian Academy of Science (1948).

In his life time, Kapitza received numerous awards which include the USSR state prize, the title of Hero of Socialist Labor, the highest distinction of the USSR, the Order of Lenin six times, the Faraday Medal of the Institute of Electrical Engineers, the Franklin Medal of the Franklin Institute, the Lomonosov Gold Medal of the USSR Academy of Sciences, the Rutherford Medal of the Institute of Physics, London, and Sir Debprasad Sarbadhikari Gold Medal of the University of Calcutta.

Kapitza wrote three books, namely (1) High Power Microwave Electronics (2) Experiment, Theory and Practice and (3) Le Livre du problem de physique. His collected papers were published in three volumes.

With all these distinctions, Kapitza lived a glorious life for nearly ninety years with vigorous scientific activities for more than sixty years.

In his early life, Kapitza faced serious tragedies by losing his wife and only son. Later on, he married Anna Krylovna, a second time. They had two sons, both scientists in profession. The other tragedies in his life were the hindrance to work in the Cavendish Laboratory after 1935 in spite of a serious agitation in the scientific community of the world and his house confinement during 1946-1964. In this period he lost his affiliation with his Institute for Physical Problems, which he built from nothing and nurtured it from the very beginning as its Director. □

S. B. Karmohapatro

NOTES & NEWS

Variable Energy Cyclotron at Calcutta Development in 1984

In July 1984 a new schedule of cyclotron operation was introduced. The cyclotron operated round the clock for two weeks continuously followed by one week of maintenance. This mode of operation significantly improved the efficiency of the machine and hence the beam time available for experiments also increased. Subsequently from October onwards further improvement in the machine operation is made and the cyclotron is now operational for three weeks continuously followed by one week of maintenance. This is a factor of two improvement from the earlier routine of four days running followed by three days of maintenance in a week's time.

The dividend of this exercise turned out to be rewarding—the performance efficiency of the machine has greatly improved with the beam on target for over 70% of the allotted time despite frequent power dips from the external power grid and other non-essential niggling problems. Clearly, quite a few of the hardware problems which plagued the operation in the previous cycle have been ironed out just by virtue of running the machine continuously. The general quality of the beam has also improved greatly. We are now going to adopt this pattern as a routine and hope to go for continuous running with occasional maintenance shut downs.

Efforts are on to improve the beam quality. Requirements on the beam quality vary from one experiment to other. Pulsed nature of the cyclotron beam is ideally suited for studies of nuclear isomeric states. For spectroscopy of nuclear isomeric states having lifetimes in the range 20 to 100 nanoseconds, it is desirable to have projectile beam pulse widths less than 10 nanoseconds. This is also true for studies of fission isomeric states having lifetimes less than 100 nanoseconds. Moreover, for measurements of nuclear lifetimes in the nanoseconds range, the exact shape of the beam pulse time structure is required as an input.

Systematic studies have been carried out to optimize the VEC alpha beam time structure. For this, the gamma ray time spectrum method with fast time resolution (300 picoseconds) is utilized to study the time structure of the alpha beam. Without any internal slit and using a bevelled ion source slit, the beam pulse width was measured to be 15.4 nanoseconds at a pulse separation of 141.2 nanoseconds corresponding to the cyclotron frequency 7.082 MHz and alpha beam energy of about 40.0 MeV. By using an unbevelled slit on the ion source and optimizing the central region parameters, particularly the dee voltage, the pulse width was reduced down to 4.0 nanoseconds. This improvement in the pulse width was brought about by two facts i.e. (a) in the case of unbevelled slit the extracting electrical field between the ion source and the puller electrode did not penetrate well into the plasma column resulting in a smaller accepted RF phase range and (b) increasing the phase bunching effect which is prominent in the first two or three turns. In this region the ions spend considerable fraction of their revolution time under the influence of the electric field. This performance of the VEC compares well with the performances of similar cyclotrons in operation elsewhere and has been reproduced recently with the set of parameters found a few months earlier.

The following are some of the research problems which were pursued in the Variable Energy Cyclotron in 1984 :

(1) Angular distribution of alpha elastic scattering on Au-197 at $E = 36$ MeV was measured and analysed in terms of optical model.

(2) Alpha inelastic scattering from Te-130 was investigated at $E \doteq 40$ MeV to obtain information about the quadrupole deformation parameter and the excitation mechanism.

(3) Single proton transfer reaction induced by alpha particles on Al-27 at $E = 40$ MeV.

(4) Radiation chemistry of liquids or solutions in high LET region to correlate the experimental data with 'spar overlap' model.

(5) Radiation damage and annealing behaviour of defect on 30 MeV α irradiated Molybdenum with $\sim 1.2 \times 10^{17}$ α/cm^2 ; Nickel single crystal with 0.7×10^{17} α/cm^2.

(6) Effect of α irradiation on the super conducting critical temperature as well as lattice parameter on a Nb_3Sn layer.

(7) Properties of radiation induced lipid peroxidation. ☐

VECC News Letter

Electric power from rice paddies

One farm on the Ili river in Eastern Kazakhstan is now getting electric power from rice paddies.

The rice paddy, submerged in water, is a huge natural battery. This conclusion has been reached by Academician Vladimir Borovsky, Director, Soil Institute of the Kazakh Academy of Sciences. It heralds a truly revolutionary change in the growing of this crop of paramount importance to man. The roots of rice seedlings are within the negative soil potential. In the meanwhile, the stalks are washed by the positively charged electrolytes—a weak solution of salts in the irrigation water. And wherever there is a potential difference, electric current is inevitable.

The hypothesis was tested in practice. In early spring, before flooding the paddies, part of electrodes were put straight on the soil. Another part of them were buried. And the paddies began generating electric power. ☐

Soviet Features

Juniper tree protects against pathogenic bacteria

Scientists of Kirghizia (Soviet Central Asian Republic) have developed a very simple technology of extracting oil from juniper trees which are abundant in this region.

Since time immemorial, it has been known that a child sleeping in a juniper cradle will grow healthy and strong. The scientists have established that the plant releases phytoncides which protect human organisms against pathogenic bacteria.

The juniper oil, called Archa, quickly heals small cuts, certain skin diseases, burns, bedsores, etc. It can also be used as an anaesthetics against attacks of rheumatism, osteochondrosis and other similar ailments. The food industry will add Archa to its products as an aromatic and medicinal agent.

The oil is extracted from the wastes of timber and wood-working industry. □

Soviet Features

LETTERS TO THE EDITOR

Effect of different treatments and date of harvesting on pectin methyl esterase activity during ripening of Patharnakh pear fruits, *Pyrus pyrifolia* (Burm.) Nakai

The changes in cell-wall composition which accompany the softening of ripening fruit apparently result from the action of enzymes produced by the fruit. Prominent among the enzymes implicated are polygalacturonase and pectin esterase, because striking changes in wall pectin content are observed in ripening fruit. Holl[2] found that softening of the fruit was associated with the rise in activity of many hydrolytic enzymes. He observed an increase in the activity of pectin methyl esterase during ripening of the fruit. Patharnakh is the commercial cultivar of pear in Punjab and the area under this fruit crop is increasing fast. Its fruit is very hardy in nature. Keeping in view, the present investigation was undertaken to see the effect of different treatments and date of harvest on pectin methyl esterase and its relation to the softening of fruit.

The study on the ripening behaviour of Patharnakh pear fruits were conducted in the Department of Horticulture, PAU, Ludhiana during 1980 and 1981. The fruits were obtained from 14-year-old trees growing at RFRS, Bahadurgarh (Patiala).

The fruit samples were collected randomly from the trees at weekly intervals over a 22-day period beginning July 22 during 1980 and July 15 in 1981. Thirty fruits of each harvest date were given the six different treatments (Table 1). Fruits of each harvest date were dipped in ethrel solution for 2 min, air-dried and kept at room temperature and the fruits were tightly wrapped in newspaper enclosing CaC_2 in a vial which was moistened with a drop of water. Temperature of 21-24°C was maintained in the incubator.

For the enzyme extraction, the fruit samples were stored immediately in a freezer at 0°C till their further use. The fruit pulp was subsequently ground in a chilled mortar with the extraction buffer (2 g pulp in 10 ml of phosphate buffer, 6.5 pH). Polyvinyl pyrolidine (PVP) was added along with the extraction buffer to avoid any inactivation of the enzyme by the phenolic constituents of the Patharnakh pear. The extracts were centrifuged at 10,000 rpm for 10 min in a refrigerated centrifuge at 0°C and enzyme activity was studied immediately. The method of Dingle *et al.*[1] was followed for the estimation of PME. The activity of this enzyme was determined by measuring the increase in acidity after the dydrolysis of pectin by the enzyme preparation. The PME activity was calculated as the microequivalents methoxyl groups liberated per hour by one ml of the enzyme preparation under the specified conditions of the reaction. Total soluble proteins were estimated by the method of Lowry *et al.*[4]

The fruit firmness was measured with the help of 'Fruit-Tester' Penetrometro after removing a skin about one square inch (2.5 cm). Ripening the fruits with calcium carbide (2 g/5 kg fruit), ethrel 1000 ppm, temperature (21-24°C) and calcium carbide (1 g/5 kg fruit) increased the PME activity significantly during 1980 (Table 1). Ripening the fruits with calcium carbide (2 g/5 kg fruit) recorded the highest PME activity during 1980 and 1981. The second best treatment with regard to PME activity was ethrel 1000 ppm and calcium carbide at the rate of 1 g/5 kg of fruit during both the years. The lowest PME activity was recorded in case of fruits under control during both the crop seasons. Similar results have been reported by many workers on different fruits[2,6]. An increase in the activity of PME on DNA basis has been reported with the ripening of Japanese pear fruit[7]. A little change in the PME activity of of Bartlett pear was reported[8].

The date of harvest had a significant effect on the PME activity in the pear fruit during both the years of study (Table 2). The lowest PME activity was recorded in case of the fruits harvested on July 15 and July 22 during 1981 and 1980 respectively. There was a progressive increase in the activity of PME with each delay in the date of harvesting from July 22 to August 12 and July 15 to August 5 during both the years. Ripening the fruits for 12 days resulted in an increase in the PME activity during both the fruiting season.

TABLE 1 : **Effect of different treatments on the PME activity and firmness in fruits after 12 days of ripening**

Treatment	Pectin mathyl esterase (meg/hr/mg protein)			Firmness (kg/inch^2)		
	1980	1981	Average	1980	1981	Average
Ethrel 500 ppm	0.009	0.011	0.0100	7.33	7.13	7.230
Ethrel 1000 ppm	0.012	0.013	0.0125	7.29	6.97	7.130
CaC_2 1 g/5 kg fruit	0.011	0.015	0.0130	7.19	6.97	7.080
CaC_2 2 g /5 kg fruit	0.014	0.018	0.0160	6.94	6.67	6.805
Temperature (21-24°C)	0.011	0.014	0.0125	7.71	7.33	7.520
Control	0.007	0.010	0.0085	7.82	7.50	7.660
C. D. at 5%	0.003	NS		0.48	0.40	

TABLE 2 : **Effect of date of harvest on the PME activity and firmness in fruits after 12 days of ripening**

Date of harvest (1980)	PME (meg/hr/ mg protein) (days after ripening)		Firmness (kg/inch^2) (days after ripening)		Date of harvest (1981)	PME (meg/hr/ mg protein) (days after ripening)		Firmness (kg/inch^3) (days after ripening)	
	0	12	0	12		0	12	0	12
July 22	0.002	0.007	8.85	7.74	July 15	0.001	0.007	9.00	7.59
July 29	0.004	0.010	8.70	7.53	July 22	0.005	0.012	8.87	7.35
Aug. 5	0.007	0.014	8.50	7.24	July 29	0.008	0.016	8.67	6.81
Aug. 12	0.008	0.013	8.27	7.01	Aug. 5	0.009	0·020	8.40	6.63
C. D. at 5%		0.002		0.39			0.005		0.33

It is interesting to note that with an increase in the PME activity, there was corresponding decrease in the fruit firmness in the fruit treated with ethrel and calcium carbide. Hultin and Levine[8] have also reported similar results in banana. Holl[2] found that softening of the fruits was associated with the rise in activity of many hydrolytic enzymes.

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Improving sex ratio in sweet lime by planofix and ethrel

The sweet-lime fruit (*Citrus limettioides* Tanaka) commands the market during August-September due to its early ripening and therapeutic value as compared to all other citrus species commercially raised in Punjab. The cultivation of sweet-lime, however, is limited because of its shy-bearing habit which is due to considerable high proportion of staminate flowers[1-3]. Scanty information is available on the effect of growth regulators on sex ratio in this species[4,5]. Therefore, a study was conducted to assess the role of different growth regulators-planofix (a commercially available form of naphthaleneacetic acid) and ethrel [(2-chloroethyl) phosphonic acid] in modifying sex expression in this species for better fruit set.

Seven-year old trees being grown at the Fruit Research Station, Bathinda were selected for experimentation. The trees were sprayed with 250, 500 and 1000 ppm solutions of planofix [a product of May & Baker (India) Ltd.] and ethrel (a product of Agromore Ltd., Bangalore) on February 21, 1984. Experiment was replicated thrice, keeping one tree as a treatment unit. The trees sprayed with water served as controls. Male and the hermaphrodite flowers were counted from all sides of the tree. On each tree, five hundred flowers were observed for their sex. The angular transformation of data was done.

Both growth regulators increased the percentage of hermaphrodite flowers and the increase was a direct function of the concentration of the chemical applied (Table 1). However, the maximum amount of hermaphrodite flowers was obtained by 1,000 ppm planofix.

TABLE 1 : Effect of planofix and ethrel on percent hermaphrodite flowers

Treatment (ppm)		Hermaphrodite flowers (%)
Planofix		
	250	19.36(10.99)
	500	27.00(20.61)
	1,000	34.11(31.45)
Ethrel		
	250	18.63(10.21)
	500	24.69(17.45)
	1,000	32.05(28.16)
Control		18.24(9.80)
C. D. at 5%		3.73
C. D. at 1%		5.23

Figures in parentheses are retransformed values.

This clearly indicates that trees of sweet-lime should be sprayed with higher concentrations of planofix or ethrel for improving sex-ratio and subsequent fruit set.

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Reproductive potential of *Cotesia diurnii* Chalikwar and Nikam (Hymenoptera : Braconidae), a larval parasitoid of *Exelastis atomosa* Fab. in relation to host density

The ratio of increase of parasitoids from generation to generation with host densities largely depend on their searching activity and responses to variable host densities. The present host parasitoid model suggests parasitoid-searching ability and reproductive potentiality which are optimum for their selection in biocontrol. However, few attempts[1-5] have been made on the aspects of host/parasitoid interaction.

Early second instar larvae of *E. atomosa* were exposed in densities of 10, 20, 30, 40 and 50 to a mated female parasitoid for 24 hr fed on fresh pigeonpea pods and 20% honey. Parasitized hosts were separated in plastic containers for futher observations made at laboratory conditions (24±1°C, 55 - 60% R.H.).

TABLE 1 : Reproductive potential of *C. diurnii* in relation to host density

Host density	No. of replicates	Total number of individuals obtained			% of Emergence of moths and parasitoids	Mean % of parasitism
		Moths	Parasitoids	Both		
10	8	52	10	62	77.50	16.12
20	8	92	20	112	70.00	17.85
30	8	145	35	180	75.00	19.44
40	8	200	50	250	78.12	20.00
50	8	251	49	300	75.00	16.33

Mean percent parasitism based on total number of parasitoids and moths.

The number of parasitoids obtained from host density 40 was highest, 50 with 20% parasitism as compared to other host densities, 10, 20, 30 and 50 recorded 16.12, 17.85, 19.44 and 16.33 percent parasitism (Table 1).

In *orgilus lepidus* Muesebeck, parasitoid of *Pthorimaea operculella* Zeller parasitoid progeny increased with increase in the number of hosts and maximum progeny was produced from 150 larvae[3]. Ninety host larvae of *Kaiferia lycopersicella* (Walsingham) was optimum number for maximum parasitism by *Apanteles dignus* Muesebeck.[1] Odebiyi and Oatman[4] reported that in *Agathis gibbosa* Shenefelt 100 larvae of potato-tuber moth was the most effective number for maximum progeny production while potato tubers with 50, 75, 125 and 150 larvae produced less parasitoids. In the present form, 40 host density produced maximum progeny production (50) and parasitism (20%) with definite host parasitoid relationship. On the other hand, Yeargan and Latheef[5] recorded no density dependent relationship between host and parasitoid in *Hypera postica* (Gullen.) and *Bathyplectes curculionis* (Thom.). In *Compoletis chlorideae* Uchida, parasitoid of *Heliothis armigera* (Hubn.) 40 host larvae has optimum host density which produced 40.68% progeny[2]. These findings are in agreement with definite host-parasitoid relationship for reproductive potetial.

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Effect of water stress on some aspects of nitrogen metabolism in *Vigna* seedlings

Adaptive responses of a plant against any environmental stress must be reflected in its metabolism through gene expression[1]. Rapid alteration in nitrogen metabolism during water stress is an advantage to plants. In the present study, some specific stress-responses in terms of protein, amino acids, proline and total nitrogen content and activities of some enzymes related to it were followed to elucidate the role of nitrogen metabolism in stress-tolerance of seedlings.

TABLE 1 : Relative water content (RWC), leaf water potential (LWP), protein content (mg (100 mg dry wt)$^{-}$), protease activity, glutamate pyruvate transaminase (GPT) activity, glutamate oxaloacetate transaminase (GOT) activity, free amino acid (mg (100 mg dry wt)$^{-1}$), proline (μ mole (100 mg dry wt)$^{-}$) and total nitrogen (mg (100 mg dry wt)$^{-1}$) content of *Vigna* seedlings (17-days-old) subjected to different magnitudes of water stress for 2 days. Enzyme activities were expressed as enzyme unit (100 mg dry wt)$^{-1}$ min^{-1}

Magnitude of water stress (MPa)	RWC (%)	LWP (MPa)	Protein content	Protease activity	GPT activity	GOT activity	Free amino acid content	Proline content	Total nitrogen content
Non-stress (control)	98.9	−0.52	61.5	0.024	0.038	0.019	0.86	8.7	6.04
−0.5	93.4	−1.0	36.0	0.030	0.020	0.0090	0.88	10.5	7.15
−1.0	90.0	−1.55	00.2	0.038	0.013	0.0080	1.13	16.4	8.31
−1.5	86.0	−2.20	24.5	0.044	0.010	0.0080	1.23	19.6	9.0
C.D. at P =0.05	0.91	0.24	4.02	0.005	0.09	0.004	0.08	0.83	0.54

Vigna seedlings were prepared and water stress was maintained by the method of Mukherjee and Choudhuri[2]. In one experiment, seeds were pretreated with $CaCl_2$ solution according to the method described earlier[3] and 15-day-old seedlings were raised thereafter. Now, 2 lots of Ca-pretreated seedlings were subjected to water stress for 2 days by immersing the root systems of plants in PEG-6000 solution at −1.0 MPa only. All the plants were maintained in a growth-room (12 h light and $\mu E\ m^{-2}\ sec^{-1}$ and 24±2°C).

After the water stress, the sampling was done by following Mukherjee and Choudhuri[2] and then following studies were made. The relative water content (RWC) and leaf-water potential (LWP) were estimated following the method given by Mukherjee and Choudhuri[2]. Protein was extracted from the residue of a methanolic extract of chlorophyll by digestion with 2 ml of 1 M NaOH for 20 min at 80°C and estimated by the method of Lowry *et al*[4]. Total free amino acid content was determined by ninhydrin method[5] from the ethanolic extract of the leaf tissue. Proline was estimated following the method of Bates *et al*[6]. Protease activity was assayed following the method described by Mukherjee and Choudhuri[7]. For the estimation of glutamate pyruvate transaminase (GPT) and glutamate oxaloacetate transaminase (GOT) 500 mg leaf samples were homogenised with cold 0.1 M phosphate buffer (pH 7.4). The homogenate was centrifuged at 5000 g for 5 min. The filtrates were used as enzyme sources. Both the enzymes were assayed following the method of Reitman and Frankel[8]. Total nitrogen was estimated from dried leaf tissue by digesting it with conc H_2SO_4. After complete digestion, a few drops of fresh H_2O_2 was added and the volume was made up to 200 ml with distilled water. Now total nitrogen content was estimated with Nessler's reagent[9]. The experiments were replicated 6 times from two independent sources and were statistically analyzed[8].

Seedlings subjected to a stress of – 1.0 MPa suffered reproducible stress effects (Table 1). Water deficit resulted in a decline of protein content. This decline might be caused by the impairment of protein synthesizing machinery[10–12] or might be a consequence of hydrolysis of protein. The decrease in GPT and GOT activities during water stress supported the earlier observations of Gupta and Sheoran[13] who demonstrated that water stress reduced the rate of protein synthesis in *Brassica* sp. by reducing GPT and GOT activities. That considerable protein hydrolysis occurred in the present case could be substantiated by higher protease activity and by accumulation of free amino acids in stressed seedlings. There was a substantial accummulation of amino acids including proline in water-stressed seedlings which is reminiscent of the observations of other workers in different plants[14, 15]. It seems likely that higher proteolysis concomitant with lower protein synthesis might be one of the major causes of proline accumulation in water-stressed *Vigna* seedlings. Higher total nitrogen content in leaves of seedlings than in nonstressed plants (Table 1) might result from either non-mobilization of nitrogenous components from leaves to other parts of the plant[16].

Several reports have indicated that Ca is an important hardening agent against water stress in field-grown crop plants[17, 18]. Here also, Ca treatment improved water status of *Vigna* seedlings significantly (Table 2). Ca-mediated improvement in protein content might be due to decreased protease activity and increased GPT and GOT activities and such improvement was also accompanied by a decrease in free amino acids including proline. Sashidhar *et al.*[19] observed in groundnut that treatment of Ca increased proline level and suggested that Ca-induced increase in proline is presumably involved in osmotic adjustment of tissues making the plant tolerant against drought. To the contrary, the present study showed a decline of proline in Ca-treated seedlings with significant improvement in water status. It appears that improved water status creates a condition which is not conducive to proline accumulation. Such observation also finds support from that of Nayek *et al.*[17] in field-grown rice plant. Ca-treatment also prevented accumulation of nitrogen in stressed-leaf

TABLE 2 : **Effects of pretreatment of seeds with $CaCl_2$ (10^{-2} and 10^{-4} M) on relative water content (RWC), leaf water potential (LWP), protein content (mg (100 mg dry wt)$^{-1}$), protease activity, glutamate pyruvate transminase (GPT), glutamate oxaloacetate transaminase (GOT) activity, free amino acid (mg (100 mg dry wt)$^{-1}$), proline (μ mole (100 mg dry wt)$^{-1}$) and total nitrogen content (mg (100 mg dry wt)$^{-1}$) of *Vigna* seedling (17 days old) subjected to –1.0 MPa water stress for 2 days. Enzyme activities were expressed as enzyme unit (100 mg dry wt)$^{-1}$ min^{-1}**

Treatments	RWC (%)	LWP (MPa)	Protein content	Protease activity	GPT activity	GOT activity	Free amino acid content	Proline content	Total nitrogen content
Non-stress (control)	98.9	–0.52	61.5	0.024	0.0380	0.019	0.86	8.8	6.04
10^{-2}M $CaCl_2$ + Control	99.2	–0.48	65.4	0.012	0.0395	0.020	0.72	6.4	5.90
10^{-4}M $CaCl_2$ + control	98.9	–0.51	62.3	0.019	0.0383	0.019	0.84	7.3	5.95
Stress (–1.0 MPa)	90.0	–1.55	30.2	0.038	0.013	0.0086	1.13	16.4	8.31
10^{-2}M $CaCl_2$ + Stress	92.4	–1.34	37.1	0.028	0.027	0.0135	0.97	12.4	7.01
10^{2}M $CaCl_2$ + Stress	91.0	–1.45	33.1	0.032	0.018	0.0094	1.09	14.1	8.02
C.D. at $P = 0.05$	1.01	–0.20	3.10	0.006	0.010	0.003	0.09	0.91	0.97

tissue (Table 2), indicating a lower breakdown of nitrogenous compounds. Active mobilization of nitrogen to other sites from leaves might also be one of the reasons of depleted nitrogen in Ca-treated stressed leaves of *Vigna* seedlings. This can also be justified by the fact that Ca is known to play an important role in the transport system by maintaining the membrane in a functional state[20].

Thus, it can be suggested that both protein synthesis and breakdown were effected by water stress and an improvement of water status causes an improvement in protein status of stressed seedlings. It also seems that increased proline level with adverse water status and decreased proline level with favourable water status might not be related to osmotic adjustment of stressed *Vigna* seedlings and consequently with drought tolerance.

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New records and host range of predators of aphids (Aphididae : Homoptera) in Kashmir Valley, India

A detailed survey of natural enemies of aphids of Kashmir Valley from 1975-1982 has revealed seventeen species of insect predators belonging to different orders *viz.*, Coleoptera, Diptera and Heteroptera, attacking twenty five species of aphids. The predatory species are recorded for the first time from this region. The various aphid predators were collected by laboratory rearing of aphid colonies brought from various localities and ecological habitats of Kashmir Valley.

Previous work with respect to the aphid predators of Jammu & Kashmir State has been done by : Hull[1], Zaka-ur-Rab[2], Kapur[3] ; Lambeck and Brink[4] and Ahmad & Vaishnavi[5]. In this communication, the newly recorded species of aphid predators, with host range and other collection data are listed below. The material dealt with here are deposited in the Museum of P. G. Department of Zoology, Kashmir University.

COLEOPTERA

I. Bruchidae

Bruchidius sp.

Host : *Amphicercidus tuberculatus* David, Narayanan and Rajasingh from *Lonicera quinquelocularis*, 9.vi.1977, Zeetyar, Srinagar.

II. Cassidinae

Aspidomorpha indica Boheman

Host : *Acyrthosiphon rubi* Narzikolov from *Rubus fruticosus*, 6.vii.1980, Kokernag.

III. Coccinellidae

1. *Adalia tetraspilota* (Hope)

Host : *Aphis craccivora* Koch from *Robinia pseudoacacia*, 12.vi.1980, Srinagar and from *Medicago sativa*, 26.v.1979, Srinagar ; *Aphis gossypii* Glover from *Zennia elegans*, 11.vi.1980, Cheshmashahi, Srinagar ; *Aphis* sp. from unidentified plant, 6.vii.1982 ; *Myzaphis rosarum* (Kaltenbach) from *Rosa webbianna*, 5.v.1977, Srinagar.

2. *Aiolocaria hexaspilota* (Hope)

Host : *Tetraneura* sp. from *Ailantus altissma*, 17.vi.1977, Ducksum.

3. *Coccinella undecimpunctata* Linnaeus

Host : *Aphis pomi* De Geer from *Pyrus malus*, 26.vi.1980 ; Srinagar

4. *Coccinella* sp.

Host : *Aphis craccivora* Koch from *Medicago polymorpha*, 8.vi.1978, Srinagar.

5. *Platynaspis saudersii* Crotch

Host : *Aphis kurosawai* Takahashi from *Daphne oleoides*, 25.x.1973, Shankracharya Hill, Srinagar.

6. *Synharmonia conglabata* (Linnaeus)

Host : *Aphis fabae* Scopoli from unidentified plant, 5.vi.1979, Srinagar.

DIPTERA

I. Chamaemyiidae

1. *Leucopis* (*Leucopis*) sp.

Host : *Aphis* sp. from *Pyrus malus*, 14.vi.1978, Hazratbal, Srinagar ; *Hyalopterus pruni* (Geoffroy) from *Phragmites communis*, 9.viii.1975, Ashaibagh, Srinagar.

2. *Leucopis* sp.

Host : *Macrosiphoniella sanborni* (Gillet) from *Chrysanthemum morifolium*, 12.v.1977, Cheshmashai, Srinagar ; *Prociphilus* sp. from *Lonicera* sp., 4.vi.1978, Tangmarg near Gulmarg.

II. Drosophilidae

Scaptomyza (*Parascaptomyza*) *pallida* (Zetterstedt)

Host : *Aphis fabae solonella* (Theobald) from *Rumex nepalensis*, 26.vi.1978, Gulmarg.

III. Syrphidae

1. *Episyrphus balteatus* (De Geer)

Host : *Aphis craccivora* Koch from *Robinia pseudoacacia*, 10.v.1976, Srinagar ; *Indochaetophorus furcatus* Verma from *Ulmus wallichiana*, 27.vi.1978, Srinagar ; *Schizoneurella indica* Hille Ris Lambers from *Ulmus* sp.

2. *Sphaerophoria indiana* Bigot

Host : *Hyalopterus pruni* (Geoffory) from *Prunus domestica*, 1. v. 1976, Hariparvat, Srinagar.

3. *Syrphus* sp.

Host : *Chaetosiphon chaetosiphon* (Nevsky) from *Rosa* sp., Zabervan, 11.v.1975 ; *Lipaphis erysimi* (Kaltenbach) from *Brassica campestris*, 4.v.1976 ; Malbagh, Srinagar ; *Eriosoma lanigerum* (Hausman) from *Pyrus malus*, 9.vi.1975.

HETEROPTERA

I. Anthocoridae

1. *Anthocoris* sp.

Host : *Pemphigus immunis* Buckton from *Populus ciliata*, 12.vi.1976, Srinagar.

2. *Orius* (*Orius*) *lindbergi* Wagner

Host : *Anuaphis persicae* (Smith) from *Prunus amygdalous*, 30.iv.1975 ; Srinagar ; *Aphis craccivora* Koch from *Medicago sativa*, 27.v.1982, Hazratbal, Srinagar ; *Macrosiphoniella artemisae* (Boyer de Fonoscolombe) from *Artemisia* sp., 27.vi.1980, Shankracharya Hill, Srinagar ; *Pemphigus mordvilkoi* Cholodkovsky from *Populus caspica*, 12.viii.1977, Srinagar.

3. *Orius* (*Heterorius*) *minutus* (Linnaeus)

Host : *Amphicercidus tuberculatus* David, Narayanan and Rajasingh from *Lonicera quinquelocularis*, 7.iv.1977, Srinagar ; *Brachycaudus cardui* Linnaeus from *Carduus edelbergi*, 6.vi.1975, Hazratbal, Srinagar.

The authors are highly grateful to Dr. D. N. Fotedar, Head, P. G. Department of Zoology for providing all the necessary laboratory facilities. Many thanks are due to the Director, Commonwealth Institute of

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Oocyte classification in *Bufo melanostictus*

A number of schemes have been proposed for the classification of oocytes of adult anuran amphibians[1-6]. Two schemes are available for *Bufo melanostictus*[7,8]. Since both the schemes are deficient in certain respects, an attempt has been made here to devise a classificatory scheme based on clearly discernible external and internal characters.

Female toads were collected from different localities in and around Calcutta. Following Inger and Greenberg[9], presence of oviducal convolution was regarded as criterion of maturity.

For the study of internal structure, oocytes were fixed in Smith's Fixative, dehydrated through ethyl alcohol, cleared in methyl salicylate or chloroform and embedded in low temperature paraffin. Six μm thick sections were stained in Delafield's Haematoxylin—Eosin and in Heidenhain's Azan, as modified by Czolowska[10].

In the adult toad, the ovary undergoes periodic progressive changes whereby its contained oocytes pass through a cycle of growth and differentiation for the ultimate goal of ovulation and fertilization. Each oocyte is enveloped by follicle made up of an outer ovarian-sac epithelium, a middle vascular theca and an inner follicular epithelium.

The normal development of the oocyte has been divided into seven stages (as described in Table 1) based on egg diameter, pigmentation, nuclear morphology and yolk distribution. This staging, is, in a sense, arbitrary since the growth and development of the oocytes is a continuous process. It is also to be noted that the adult ovary contains, in addition to a particular category (stage) of oocytes, one or more category of eggs, though in far lesser number.

Besides the points mentioned in Table 1, it is observed that the animal and vegetal poles are just distinguishable and the vitelline membrane is distinct in stage IV. Further, the most distinguishing feature of the oocyte of the stage VI is the presence of an equatorial unpigmented annular band (about 0.2 mm thick) separating the animal and vegetal hemispheres.

In most of the earlier schemes of oocyte classification, these easily discernible internal characters were not considered. The most notable and comprehensive classification was proposed by Dumont[6]. He grouped the oocytes into six stages taking into account precise egg diameter ranges, external pigmentation, nuclear morphology, yolk distribution, etc. Church[7] and Basu[8] divided the oocytes of *B. melanostictus* into six categories based on size and pigmentation, and five groups on the same basis and some internal characters respectively but did not indicate the size ranges. The former used the terms "small" and "large" and the latter 'small", "medium" and "large"

The classificatory scheme adopted here differs from those of earlier workers[6-8], in several respects. The most early oocytes are transparent and undifferentiated cells. These are resting stage cells in which yolk synthesis is yet to begin. These resemble the oocytes of immature animals and hence are included in STAGE 0.

Dumont's[6] Stage III is too large and includes oocytes showing a variety of pigmentation pattern beginning from "light brown to uni-

TABLE 1 : Description of different oocyte stages

Stage	0 (Previtellogenetic)	I (Vitellogenetic)	II (Vitellogenetic)	III (Vitellogenetic)	IV (Vitellogenetic)	V (Vitellogenetic)	VI (Post-vitellogenetic and pre-ovulatory)
Diameter (μm)	80-300	300-400	400-800	800-1000	1000-1250	1250-1400	1400-1600
Colour & pigmentation	Transparent; no pigmentation	Opaque ; pigmentation not externally visible	Opaque, but pigmentation visible; yellow, tan or brown	Rich dark brown pigmentation uniformly distributed	Animal pole dark brown to black, vegital pole slightly paler brown	Animal pole dark brown, vegital pole paler brown	As in V
Nucleus	Central ; large	Central : large	Central ; still large compared to the size of the cell	Slightly eccentril, large, but the increase in the ooplasmic size far outstripped the increase of nuclear size	Definitely eccentric, displaced towards the animal pole	Eccentric nucleus displaced towards the animal pole	Eccentric, situated near the top of the animal pole
Nuclear membrane	Outline smooth	Slightly wavy	Lightly folded	Deeply folded	Less deeply folded than in III	Short folds, more prominent towards the vegital pole	Slightly folded mostly on the vegital pole side
Nucleoli	None to few, scattered at random	More in number ; some lying close to the nuclear membrane	Many; located very close to the nuclear membrane, even within the folds of the nuclear membrane ; large	Many; mostly large and peripheral	Many deeper in the nucleoplasm, a few larger ones peripheral	Less in number ; mostly peripheral	Fewer, more towards the centre
Yolk	Absent	Little, in the form of small spheres at the periphery	Much increased	Much increased ; some yolk platelets small and round, other large and elongated	Further increased ; small round and compact yolk platelets towards animal pole, but larger elongated and loosely arranged towards vegital pole	Further increased ; polar distribution	Yolk platelets large ; distinct polar distribution
Cytoplasm	Homogenous filling whole cell, no cortical granules and melanosomes	With a single layer of cortical granules ; no melanosomes	Generally displaced towards the nucleus forming a broad perinuclear ring ; some scattered in irregular, isolated patches within yolk	Mainly in the form of perinuclear ring ; melanosome in the form of a continuous peripheral band	Forming definite perinuclear ring, wider towards vegital pole ; few cytoplasmic islands within the yolk ; melanosome distribution in periphery almost uniform in animal and vegital poles	Cytoplasmic island displaced towards animal pole	Few cytoplasmic islands just below the perinuclear cytoplasmic ring in the animal pole

formly blackish brown". Agreeing with Church[7] and Basu[8], oocytes corresponding to Dumont's[6] Stage III have been included into two different catagories—STAGE II containing oocytes of variable pigmentation but other than uniform dark brown, and STAGE III containing oocytes of uniform dark brown colour. A late post-vitellogenetic stage has been reported in *Rana temporaria*[3] and *Xenopus laevis*[6]. Such a stage has also been found to occur in *B. melanostictus* and described in the study as Stage VI.

TABLE 2 : Comparative chart showing major schemes of oocyte classification. Three schemes, not mentioned in the discussion are also included for comprehensiveness

<table>
<tr><th></th><th colspan="11">Stages</th><th>Reference</th></tr>
<tr><td rowspan="3">B
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F
O</td><td>0</td><td colspan="2">I</td><td colspan="2">II</td><td colspan="2">III</td><td colspan="2">IV</td><td>V</td><td>VI</td><td>Ray & Mitra</td></tr>
<tr><td colspan="3">I</td><td colspan="2">II</td><td colspan="2">III</td><td colspan="2">IV</td><td colspan="2">V</td><td>Basu, 1962</td></tr>
<tr><td>VI</td><td colspan="2">I</td><td colspan="2">II</td><td colspan="2">III</td><td colspan="2">IV</td><td colspan="2">V</td><td>Church, 1960</td></tr>
<tr><td rowspan="3">R
A
N
A</td><td colspan="3">Ia & Ib</td><td colspan="4">II & III</td><td colspan="4">IV</td><td>Rosenbaum, 1958</td></tr>
<tr><td>A</td><td colspan="2">B</td><td colspan="4">C</td><td colspan="3">D</td><td>E</td><td>Grant, 1953</td></tr>
<tr><td colspan="2">Y_0</td><td colspan="2">Y_1</td><td>Y_2</td><td>Y_3</td><td colspan="3">Y_4</td><td colspan="2">Y_5</td><td>Kemp, 1953</td></tr>
<tr><td rowspan="3">X
E
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S</td><td>I</td><td colspan="2">II</td><td colspan="4">III</td><td colspan="2">IV</td><td>V</td><td>VI</td><td>Dumont, 1972</td></tr>
<tr><td>1 & 2</td><td colspan="2">3</td><td colspan="4">4</td><td colspan="2">5</td><td colspan="2">6</td><td>Davidson, 1968</td></tr>
<tr><td>A & B</td><td colspan="2">C</td><td colspan="5">D</td><td colspan="3">E</td><td>Balinsky & Devis, 1963</td></tr>
</table>

A comparative chart showing major schemes of oocyte classification proposed by different workers and the scheme adopted here is given in Table 2.

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On the performance of some varieties of Isabgol, *Plantago ovata* L. against aphid

Isabgol (*Plantago ovata* L.) is a winter herb which has many medicinal and industrial uses. Its cultivation has been recommended in the South-Western districts of Punjab. The aphid, *Rhopalosiphum maidis*, a serious pest of wheat and barley also infests this crop. So studies were carried out to find out varieties resistant to this pest.

The studies were carried out at the research farm of the Punjab Agricultural University during 1981-82. Fifteen varieties of Isabgol were sown in the second fortnight of October in a randomized block design. The plot size was 5 rows × 3 m and there were four replications. The population of the aphids was recorded in the first and third week of March, 1982 from five spikes of a plant and on five plants from each replication selected at random, on the basis of their mean.

Table 1 reveals that Progeny-3 and EC-42706-2-2 had significantly low aphid population as compared to other varieties. However, these two varieties were statistically at par with P-79, PIS-1, PIS-2 and S-12. The remaining entries were inferior to these with regard to the damage by aphid. Highest population of aphid was recorded on S-11. Therefore, there is a scope for breeding tolerant varieties of isabgol by making use of progeny-3 and EC-42706-2-2 cultivars.

TABLE 1 : Comparative performance of varieties of Isabgol against aphid, *Rhopalosiphum maidis* during 1981-82

Cultivars	Mean* Number of aphids/ spike on		Mean	Ranks
	4.3.82	18.3.82		
EC-42706-1-2	71.0^{cde}	32.6^{de}	51.8	10
EC-42706-2-2	53.4^{ab}	19.3^{abc}	36.4	2
G-1-1	72.3^{cde}	30.5^{cde}	51.4	9
P-33	73.9^{cdef}	26.9^{bcd}	50.4	8
P-79	71.2^{cde}	16.4^{ab}	43.8	4
PIS-1	76.3^{cdefg}	22.3^{abcd}	49.3	7
PIS-2	68.8^{cd}	20.5^{abc}	44.7	5
P-11	90.4^{h}	38.8^{e}	64.6	12
Progeny-3	50.9^{a}	14.7^{a}	32.4	1
Progeny-10	82.3^{efgh}	40.4^{h}	61.4	11
Progeny-27	88.6^{gh}	40.8^{ef}	64.7	13
S-8	80.1^{defgh}	52.5^{fg}	66.3	14
S-11	85.6^{fgh}	53.2^{g}	69.4	15
S-12	63.8^{bc}	18.6^{ab}	41.2	3
Local	74.7^{cdef}	20.7^{abc}	47.7	6
C.D. ($p = 0.05$)	12.7	11.8		

*Mean of 20 spikes

Entries with same letter(s) do not differ significantly as revealed by C.D, value at 5 per cent level of significance.

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Sawed elephant bone unearthed from Barasat, 24-Parganas, W. B. : Reminiscence of ancient ivory carving in Bengal

Sometime in 1981, bones of some animals were unearthed from a depth of about 6.02 m from the surface during renovation of a pond in Gazitola, Debalaya, 24-Parganas. Among others, a large fragment of a limb bone caught the attention of the people of the locality and so subsequently it was sent to me for identification by the Director of the collection of antiquities from Chandraketugarh. Some archaeic objects like Sunga coins, potteries and figurines were also found in close association with the bones in the site of excavation. Therefore, the bone appears to be nearly 2000 years old.

The sawed-bone piece was the distal end of left femur of a very big elephant. It is reminiscent of the fact that ivory or bone carving was a traditionally old industry in Bengal or Gour-Bango. Craftsman generally discards such condylar bones for their irregular shape and rough texture.

From the dimension of the bone, it appears that the elephant concern was very big and probably it was a male specimen. It is comparable with the large mounted skeleton in the Indian Museum which has a record height of 3.86 m, at the shoulder. The girth of the shaft measured at condyle is 70 cm (*cf.* 65 cm in Ind. Mus. specimen) and the condylar width is

25 cm. (*cf.* 26 cm. in Ind. Mus. Specimen). The specimen is now in the possession of Sri Dilip Maite, Director ofthe said collection.

India as a whole, is the pioneer country in bone, horn, ivory and conch work. The Neolithic bone tools are reported from almost every where from Burzahom (Kashmir) to Arikemedu (Tamilnadu). It throws light on the skill of those primitive hunters in making pointed, barbed, hooked, serrated and perforated tools, according to various requirements. The Post-Neolithic people in latter phase started to prepare more sophisticated articles in the country like earings, bangles, necklace, combs, shieves, knives, blades and needles besides those traditional weaponds and instruments.

There after since 2500 B.C. (Harappan onward) till up to 1700 A.D. (Sultani and Nawabi time), the Kings and Monarchs in the country patronised the bone and ivory crafting and as a result the industry got tremendous impetus.

The ivory caskets, chairs, footstool etc., found from Begram, Eastern Afghanistan, remind us of the skill of ancient carvers of Mathura (1st century AD). From 8th to 14th century, different artistic objects made of ivory, were exported to outer countries, including, Nepal, Tibet, Burma, Ceylon and Afghanistan. The famous ivory centers were situated in Delhi, Mysore, Trivancore, Bengal and Orissa.

Earlier, we got similarly sawed or chopped bones of elephants from Tamluk (Midnapur) and Farakka (Murshidabad). It testifies that from time immemorial the people of Bengal were adept in ivory work. Consequently, ivory industries were established in different parts of the state to produce fine and artistic objects like dolls, toys, fans, combs, ornaments, dice, statuettes and many others, which occasionally fetched foreign currencies. The ivory work gained such fame that foreign traders who sailed from Saptogaon, Tamrolipta and Chittagaon never forgot to collect some of the ivory work as memento along with the famous Mosline clothes at the time of their departure.

It is worth mentioning that elephant is the only animal which possesses solid limb bones without marrow cavities. The inner spongy bone is encircled by the outer compact bone tissu, which serves as second-rate ivory in the work. Practically the entire skeliton of an elephant is utilised by the ivory workers. By the by we may recollect the old proverb 'a dead elephant worths a million marks'.

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Effect of nitrogen nutrition and *Rhizobium* on the physiology of mung bean infected with common bean mosaic virus

Nitrogen nutrition has long been recognised as an important factor in modifying host growth and its physiology. If the levels of nitrogen provided are lesser, a reduction in growth is obtained as a result of reduced auxin activity[1], while at the higher levels the plant showed a lusk and rank growth[2]. Miller[3] stated that carbon : nitrogen ratio (C : N) influences the vegetative growth of the plant. Though considerable literature exists on the effect of nitrogen nutrition in relation to host growth and virus multiplication[4], deviation in C : N ratio in plants has not been investigated. Therefore, the present study was made to find out the effect of nitrogen nutrition and *Rhizobium* on the C : N ratio in common bean mosaic virus (CBMV) infected mung bean plants, with a view to establish relationship, if any, between nitrogen nutrition and *Rhizobium* on it in infected plants.

Mung bean cv. Pusa Baisakhi was used as a host plant and CBMV[5] was used for systemic multiplication. Eight different levels (0, 56, 112, 168, 224, 448, 672 and 784 ppm) of nitrogen were prepared from Bollard's solution[6]. The seedlings were raised in paraffin-coated clay pots (12 cm) having sterilized sand. The seedlings of uniform growth (10-day old) were taken in two groups, each comprising 160 pots. The first group

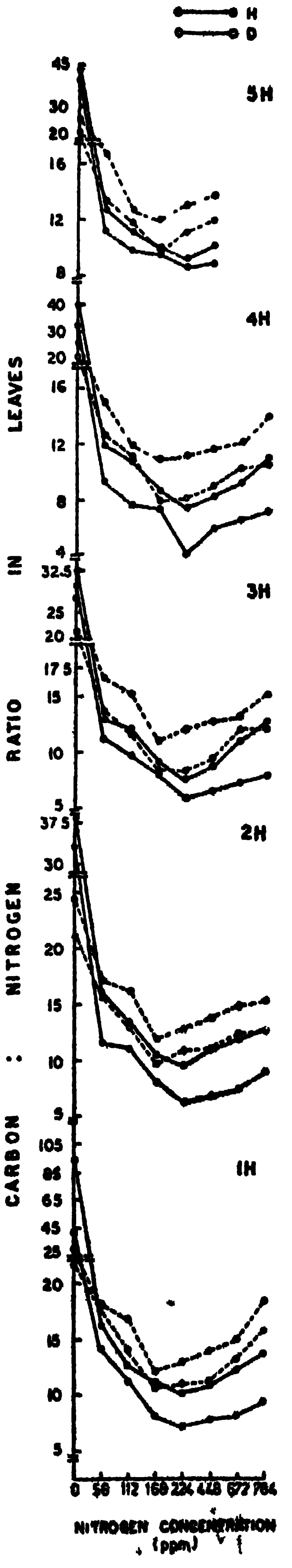

FIG. 1.

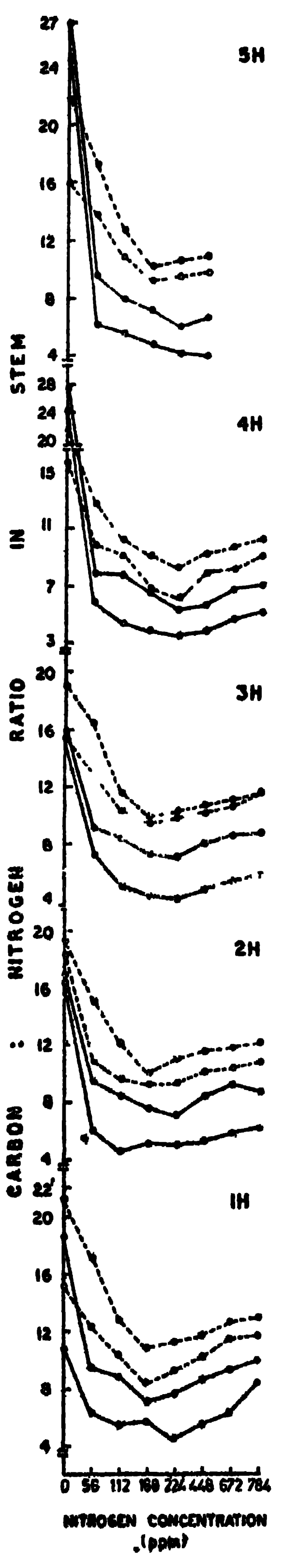

FIG. 2.

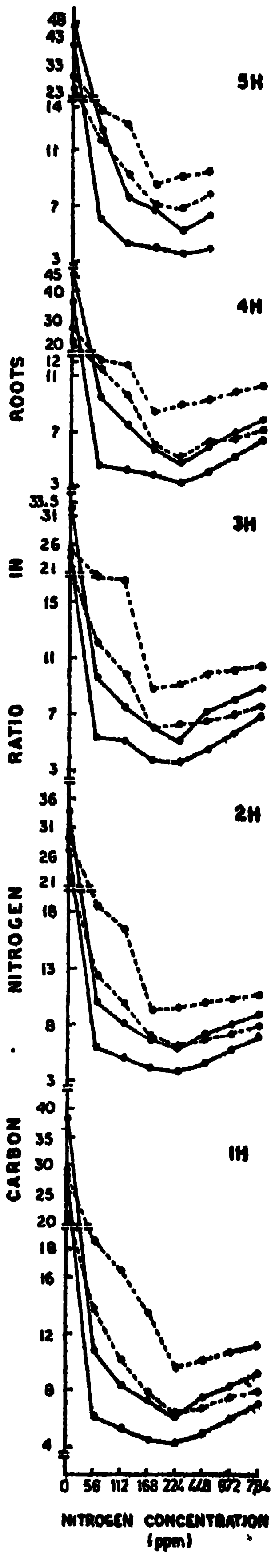

FIG. 3.

was raised from *Rhizobium* untreated (RUT) and second one from *Rhizobium* treated (RT) mung bean seeds. The *Rhizobium* inoculation of the seeds was done by placing the water-suspension of the bacteria on it. One half of the plants (400 plants) of each group were inoculated with neutral phosphate buffer only to serve as healthy control. The aforesaid four groups of the plants were designated as *Rhizobium* untreated healthy (H), *Rhizobium* untreated diseased (D), *Rhizobium*-treated healthy (RH) and *Rhizobium*-treated diseased (RD).

Ten pots, containing 50 plants were taken for each nitrogen treatment, and seedlings were inoculated by rubbing the virus inoculum over the leaf surface. The harvests were made on 10th, 20th, 30th, 40th and 50th day of inoculation. The C : N ratio in plant samples was derived by dividing the carbon content by nitrogen content of the sample.

Figures 1-3 show that virus infection lowered the C : N ratio in mung bean plants. The reduction in the C : N ratio was, however, less in RT plants than in RUT ones. The C : N ratio in RUT (H and D) and RT (RH and RD) group of plants decreased from 0 to 224 ppm and from 0 to 168 ppm of nitrogen respectively, then increased gradually to 784 ppm of nitrogen in both the groups of plants. For treatments, viz. nitrozen nutrition, virus infection and *Rhizobium* inoculation, F-value were computed for each sampling. Values of variance ratio for nitrogen nutrition and virus infection were significant at 1% level, while *Rhizobium* treatment was significant at 5% level.

In the present study, the virus infection lowered the C : N ratio. Similar findings have also been reported in several host-virus combinations[7-8]. This may be due to low organic carbon and higher nitrogen contents in the diseased plants[9]. The findings of the growth studies showed that decrease in organic carbon at different nitrogen levels (168 and 224 ppm in RT and RUT plants respectively) may be attributed to the vigorous growth of the plant at these levels, which led ultimately to the maximum depletion of organic carbon[9]. However, as soon as the nitrogen level is enhanced, the metabolic activities are suppressed on account of toxicity of nitrogen, resulting in a greater accumulation of organic compounds and thereby the organic carbon. Thus, a very high C : N ratio at 0 ppm indicates the weak vegetative growth of the plant. In this case, nitrogen appears to be a limiting factor for growth and the high ratio is apparently due to the presence of little amount of nitrogen and higher amount of organic carbon. Kraus and Kraybill[10] also gave the similar reasons for higher C : N ratio in plants.

The growth of the RT and RUT plants was maximum at 168 and 224 ppm of nitrogen respectively[9], but the C : N was low. This indicates a balance between the organic carbon and nitrogen supplied to the plants, which produced the best vegetative growth.

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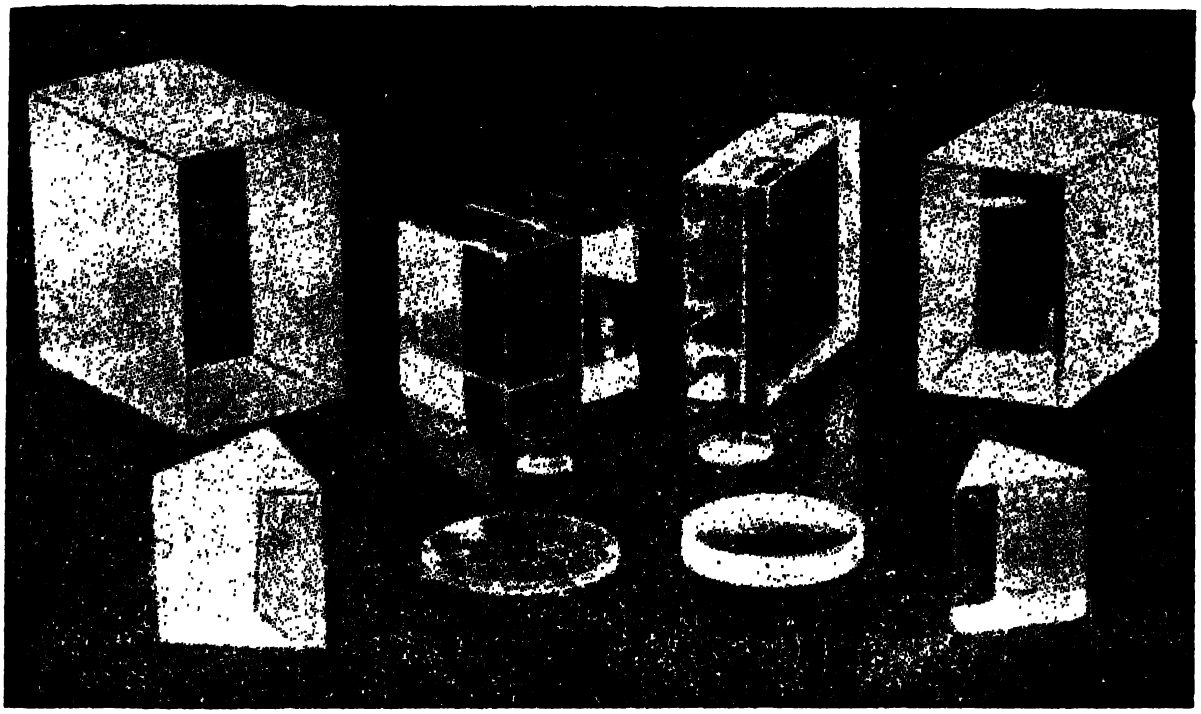

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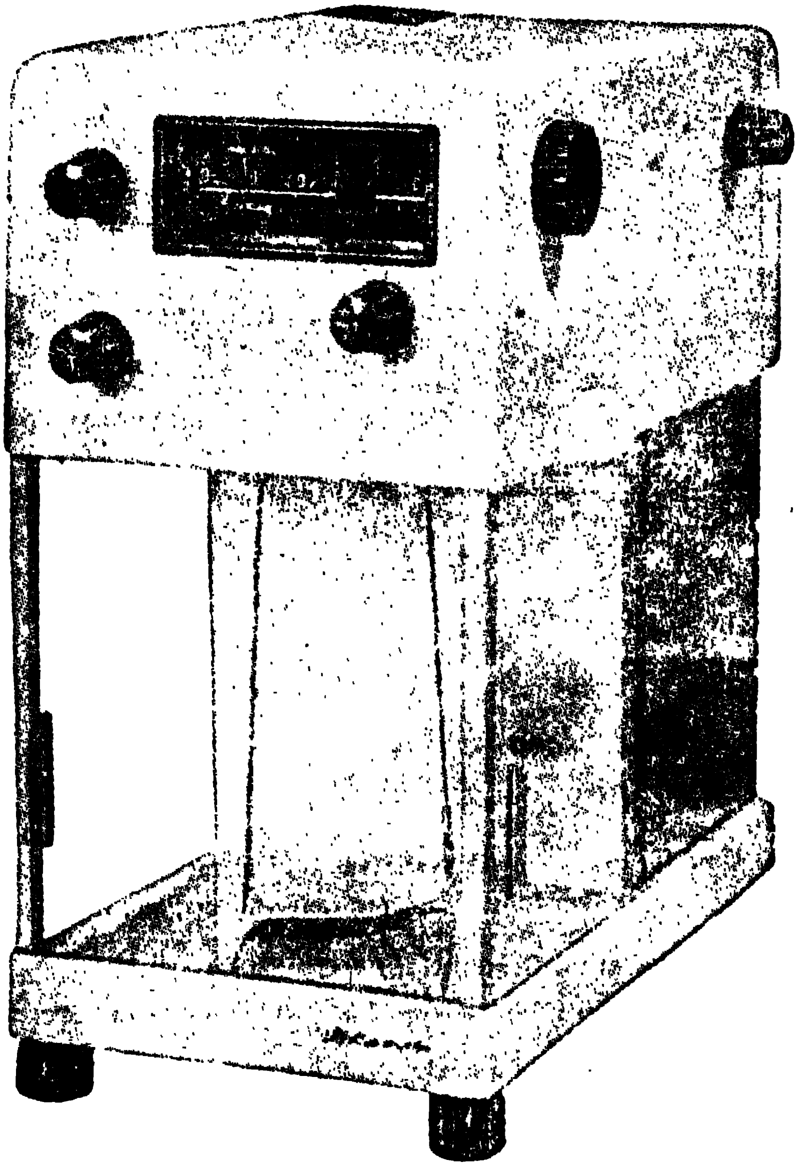

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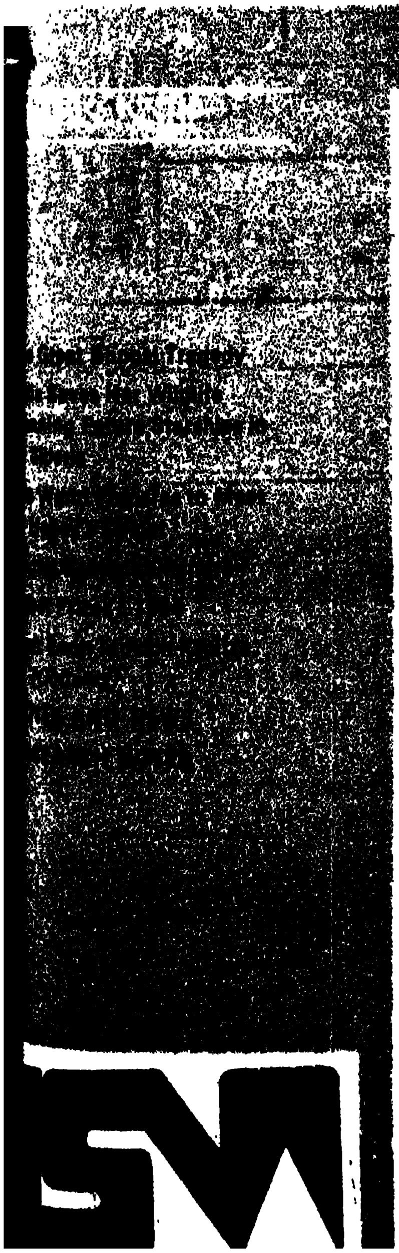

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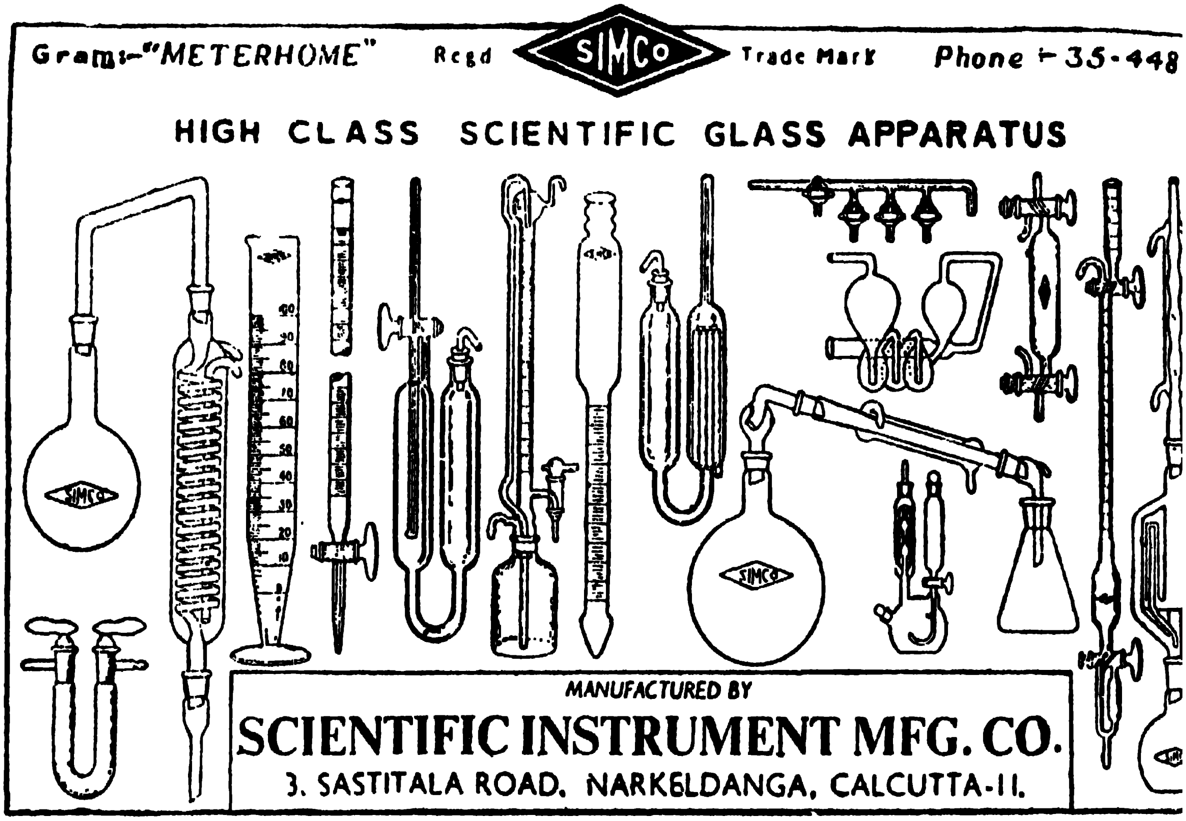
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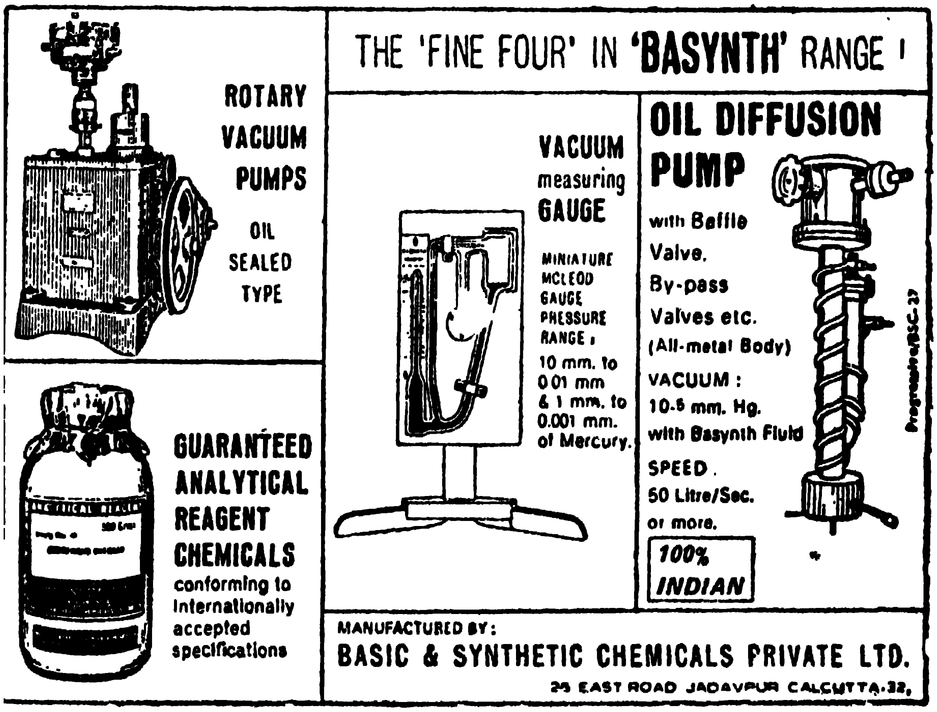
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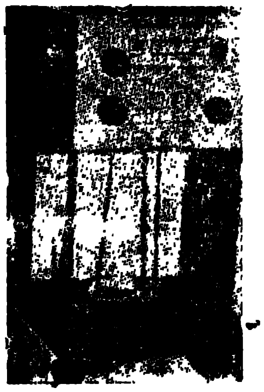

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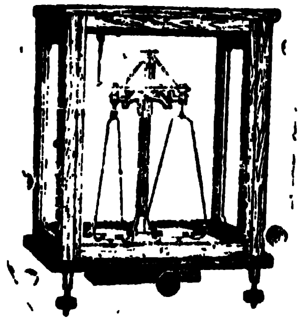

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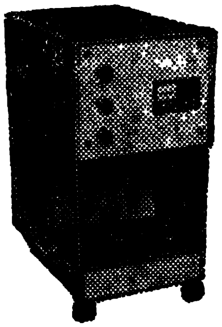

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SCIENCE & CULTURE

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THE GREAT BHOPAL TRAGEDY

IN the late fifties of this century the developed countries of the West started feeling the effect of the man made chemical pollution of the environment. In the United States, just before Thanksgiving of 1959, cranberries contaminated with the weed killer aminotriazole, known to cause cancer in rats at even low doses, had had to be withdrawn from the market. Then followed the thalidomide tragedies, when mothers who had taken the drug during pragnancy gave birth to severely deformed children all over Europe. These well publicized events and a number of other incidents in the American life led Rachel Carson to write the famous book 'Silent Spring' in 1962 which exploded on the Western world like a bolt from the blue and it sounded the death knell to many chemical, fertiliser and pesticidal companies. Long law suits were instituted but the well researched facts presented in the book prevailed. Little did I think at that time, working in the laboratory of the Columbia University that India will be faced with the man-made pollution problem in such a short period of time.

The writing of the book 'Silent Spring' was actually prompted by the fervent appeal by a nature loving friend, Olga Huckins of Carson, to do something about the aerial spraying of DDT. Huckinses had a private bird sanctury in Duxbury, Massachusetts which had been doused with DDT when the state sprayed the surrounding areas in an attempt to control mosquitoes. The graphic description of the agonising deaths of the birds by Mrs. Huckins moved Carson to do something. Her determination was further strengthened with the sueing of the government by the citizens of the Long Island to protest against aerial spraying of DDT over heavily populated suburban areas to control the gypsy moth. The government always assured that the spraying was harmless.

Unlike the researches for the earlier three famous books, on and about the Sea, Rachel Carson realised the explosive nature of the topic in hand and the tremendous pressures against her from pesticide related industries and institutions. She was determined to write the book and she accomplished her mission before dying (ironically) of cancer in 1963.

In the highly poetic sections of the silent Spring there is a 'Fable' of a horrid disaster about which Carson hastens to assure her readers that the town where all these things have happened does not exist. However, the events did take place though 14 years later. In the book, Poison that Fell from the Sky, John G. Fuller dramatically described a pesticide accident at a factory at Seveso, Italy, near Milan, where huge quantities of the toxic chemical TCP (Trichorophenyl) entered the atmosphere in 1976. The myth of the Silent Spring was changed to tragic reality. The Bhopal disaster is an unprecedented man inflicted tragedy in the entire history of humanity till today and a grim warning for the future.

The scale of the tragedy which struck Bhopal in the early hours of December 3 leaving several thousands dead and many more hospitalised has no precedence in history except may be during wars. The manner in which the poisonous gas leaked from the Union Carbide plant on the outskirts, spread southwards over the city in the still of the night and took people's lives in the midst of their sleep makes the incident a foretaste of a chemical warfare. Official figures put the death toll at around 2000, while local estimates give it ten times higher. The latter may well be an over-estimation, as can be expected from the first flush of reaction from a panic striken populace. But the true figure is in all likelihood several thousands more than the official one. Besides, nearly one fourth of the city population of over 8,00,000 is estimated to be affected by the exposure to the poisonous gas, with more than 25,000 of them inhaled it in sufficiently large quantities to make them vulnerable to serious long term hazards. A substantial section of them have already been affected with abnormalities such as loss of vision (may be temporary) hemiplagia, kidney trouble and severe malfunctioning of the respiratory tract.

The world was only slowly recovering from the shock of the industrial accident in which a natural gas explosion on 17 November 1984 at the Pemex plant of Petroleos Mexicanos in the suburbs of San Juan Ixhuetapec. It flashed the skies with hellish waves of orange, red and black and devasted the shanty town surrounding the plant. More than 30 acres of working class housings were destroyed and another 30 heavily damaged. A series of explosions not only destroyed four spherical tanks, each holding at least 420,000 gallon of liquified gas but also sent enormous shards of steel speared into the houses. The official figures of casualties were 365 dead and 2000 injured with the third of the injured not expected to live. Seveso accident (already cited) is chemical industries' own which back in 1976 simply dropped poison from the sky over the unwary people. Chemical industries are also familiar with other industrial accidents in which large number of their employees were affected. In 1963, in Amsterdam the Duphar Chemical plant's reactor vessel for Trichlorophenyl production over-heated and exploded. About a ton of chemicals, 200 to 500 gms of dioxin showered the interior of the works. The exact number of employees exposed to the chemical by the explosion and during the subsequent cleanup is not certain, but is thought to be at least 145, a large number of whom later came down with dioxin poisoning. However, the Bhopal accident dwarfs all these in magnitude of scale.

The gas, now known as methyl isocyanate (MIC) had leaked from the pesticide plant of the Union Carbide (UC), a multinational company. This highly toxic gas is used as an intermediate organic chemical by UC in the manufacture of carbaryl (brand name sevin) and temik (also known as aldicarb). Many of the intermediaries used in the pasticide industries are toxic and harmful in different degrees. Sevin and temik have very different tolerance level values (TLV) in formulation though both use MIC for their manufacture. For sevin it is 800 mg/kg whereas it is as low as 0.8 mg/kg for temik. Both sevin and temik are broad spectrum pesticides. Because of its high toxicity, Industrial Toxicological Research Centre (ITRC) Lucknow, once thought of banning temik. It would be unwise to think in terms of banning pesticides in general, because they have been the reasons for increased food production in the country over the years and they will continue to be beneficial only if the safety regulations in their manufacture and use are strictly enforced and adhered to.

Since about 1944, pesticides came into fairly wide use in the country, though the manufacture was started only in 1952. Among the South Asian and African countries, excluding Japan, India is the largest manufacturer of pesticides today. About 125 pesticides have been registered with the central Insecticide Board (CIB), Faridabad, of the Ministry of Agriculture and licensed for production and use.

The Insecticide Act of 1968 sets out the guidelines for the CIB to scrutinise every application for manufacture or marketing of pesticides. A later addition to the report also lays down the procedure for providing the basic data and information related to toxic effects at various stages of preparation of the production. However, over the years, with the increase in the number of pesticides, manufacturing processes and enterpreneurs, these guidelines have been rendered non-functional. The CIB does not have the necessary infrastructure and facilities to check the information provided in each case. The word of the enterpreneur is taken for granted. If highly sophisticated technologies and processes of high toxic new products are transplanted from abroad, where they had a record of operation without problems, they are approved without evalution and checking the suitability to our environment. Thus the act itself has been reduced to a sort of red tape, and has become, like many other government procedures, a vehicle for wide-spread corruption.

The agency (CIB) has no periodic monitoring programme of working conditions at the factories, no inspection for ensuring that safety measures are provided, no checking of the production capacity nor estimating the atmospheric concentration of toxic material near the factory site. In fact, it is doubtful whether the agency has at its disposal, either at the central or state level, persons suitably qualified to undertake the above mentioned supervision.

With this state of affairs it is not surprising that the accident in Bhopal took place and with the complementary conditions assumed the gigantic scale of a disaster. If one delves into the accident history of this Union carbide factory or for that matter many other chemical factories in the country it is rather dismal. It is only non-conducive circumstances that have saved many a situation.

The 30 tons of killer gas, which escaped into the atmosphere from the underground storage tank, on the night of 2nd December 1984 in Bhopal, reliably learnt to be methyl isocyanate (MIC), is one of the most toxic gases known. The unique properties of MIC (chemical formula $CH_3-N=C=O$, molecular weight 57.05) are that it is highly volatile (Boiling point somewhere between 37°C to 45°C, flash point −7°C) and inflamable ; its vapours (vapour density 2.2) are denser than air. This colourless liquid with a powerful odour is stable under dry and neutral conditions at room temperatures but can react violently in the presence of acids, alkali, water and other organic nucleophiles (electron-rich). The organic isocyanates are known as carbamylating agents (they lead to products known as carbamates). The carbamate insecticides are effective against several insect pests causing crop losses. Its low mammalian toxicity with high insecticidal action have taken them to domestic application (Baygon spray).

When the people thronged the hospitals in large number after the Bhopal accident, doctors were hard pressed to follow any definite line of treatment. For quite some time the killer gas was not identified and there was confusion whether it was phosgene or MIC. Once it was announced they found scanty information about the action of MIC on humans, animals or other living things. Their information only described MIC as a volatile, colourless and lachrymetory (tear producing) liquid highly irritating to skin, eyes and mucous membranes and can cause pulmonary edema. So it is not surprising (now) that the company could not provide any information on the possible line of treatment for the affected persons.

Now scientists in the country have put together various informations gathered from the tragedy. The observed physical effects in the Bhopal accident were excessive tear formation, congestion in the windpipe, pulmonary edema, and increased movements of the bowels and urinary bladder. These effects have now been understood from the point of view of extreme reactivity of MIC with compounds containing hydroxy ($-OH$) and ($-NH_2$) groups. Proteins and certain useful enzymes in the body contain both these groups and the reaction of MIC which forms new compounds either blocks or incapacitates the groups from its normal function.

Choline is an essential metabolic compound in an animal organism which builds and maintains the cell structure. It is strongly hygroscopic and forms an ester, acetylcholine, with acetic acid. Now acetylcholine is an important chemical which is released at the nerve endings in the human body. Acetylcholine controls the secretions of various glands which produce tears, saliva, mucus, stomach acidity, etc. It is also known to be responsible for the regulation of the activities of skeletal muscles, which control the body movements, and smooth the function of muscles which are present in the wind pipe, stomach, intestinal walls and urinary bladder. Under normal conditions, an enzyme called acetylcholinesterase prevents accumulation in the body of acetylcholine by hydrolysing it to choline and acetic acid. In this splitting the hydroxy group of the enzyme plays an important role. If the hydroxy group is blocked by reaction with other compounds such as MIC, the enzyme becomes inactive, acetylcholine content builds up in the body, which in turn produces many undesired symptoms (already mentioned).

Another effect of the toxic gases is to damage the thin walls of the blood capillaries through which water, oxygen and carbondioxide exchanges takes place. As a result water starts leaking and pools in the surrounding tissues, giving rise to edema. During pulmonary edema respiration is effected in this manner. This is most important, severe and common human response to toxic gases and it was evidenced by the Bhopal victims too. The long term effect depends upon the extent of the damage in the body.

Let us now try to understand the fate of MIC in the environment. An estimated 30 tons of MIC leaked from the tanks and spread over the whole volume of two kilometers radius upto a height of (approximately) 30 m. This works out to about 0.03 ppm of MIC, which is above the safe upper limit and as it is heavier than air, the concentration would have been much higher near the ground surface.

However, MIC will undergo degradation due to sunlight, as well as reactions with the moisture. Methamine, dimethyl urea and harmless other gases are the likely major products. In plants, MIC could compete with CO_2 in photosynthetic processes. As in human system, plants will also produce methylamine and other carbamylated derivatives of the plant constituents.

Thus in predicting the long term effects of the MIC contamination one has to consider the effect of this excess methylamine which is the major metabolite. According to the studies carried out at the Jefferson Medical College, Philadelphia, aliphatic amines are likely to participate in the complex metabolic derangements occurring in renal failure. In the cases of patients with kidney diseases, definite clinical toxicity was demonstated with methylamines.

There are many speculations about the causes and lapses which led to the accident at Bhopal. In the initial heat of emotions and anguish the total blame has been placed at the doors of the multinational company, the Union Carbide. It holds 51 per cent of the shares in the Indian company which is managed primerily by the principals through the Indian board. There are many questions yet to be answered and already governmenta! and non-governmental committees are enquiring into the various aspects of the whole disaster. It is sure that some exothermic chemical reactions were initiated in one of the tanks induced by some foreign substances (which may well be a seepage of water) which led to sudden building up of high pressure and leading to the catastrophe. What these enquiry committees have to see is not only the causes that led to the accident but also possible measures in minimising, if not eliminating altogether, the probability of recurrence. After all we cannot shut down the use of chemicals permanently. MIC is one of a group of widely used chemical not only in insecticides and pesticides, but also in paints and varnishes.

If chemicals bring risks that are less than those brought by the pests they destroy and other benefits they bring to humanity, then all countries, poor or rich, have every right to choose to use these chemicals. When accidents occur they do so because of human lapses in one form or other. They do not differentiate between poor and rich countries. Seveso, Pemex or the dioxin accidents in Amsterdam, and England which preceded Bhopal, occurred all over the world. The lessons are to mankind as a whole, to be cautious about taking it easy with modern technology.

We in India too should introspect about our policies, attitudes and morals. We do not hesitate either to claim the laurals of indigenisations when success is achieved in any enterprise, or in the face of disaster do we hesitate to drop the blame squarely at the doors of a scape goat. The Bhopal accident and its aftermath have put the intelligensia in the country in a dilemma and have led the common man to confusion. Many investigating committees have started looking into the causes that led to the disaster. Let them report clearly and unequivocally on the very type of neglect that the management allowed to perpetrate and the Government safety law enforcing agencies overlooked. Let the guilty be brought to book and corrective steps be taken immediately. Let us convert this great tragedy to the ushering in of a sound technological and industrial policy in the country and proper enforcement and execution of all environmental safeguards. □

B. B. Baliga

INDIA SAVES HER WILDLIFE

A. B. CHAUDHURI*

INDIA'S rich, magnificent and varied wildlife in diverse zoo-geographic, eco-climatic and phytogeographic zones has been her traditional heritage and priceless assets. The beauty and variety of wildlife resources have no limit. More than 500 species of mammals, 1200 species of avi-fauna and 30000 species of insects, 900 species of reptiles and myriads of other living organisms stand unsurpassed in her faunal resources matched by her equally diverse vegetation types.

The animals include magnificent gigantic elephants associated with the splendours of our princely pegeantry, the largest bovine such as gaur or Indian bison, the horned rhinoceros considered the greatest of all rhinoceros, the swamp deer, the breath-taking spotted deer and lastly the picturesque nilgai and the like. There are no parallels to our stately lion, the magnificent tiger, the splendourous clouded leopard, the dazzlingly painted vermillio bats Of these highly diversified and colourful faunas in India today, some however, are on the verge of extinction. Unfortunately these fauna are exhibiting retrogressive tendencies owing to biotic interferance.

Unique Biogeographic realm

India has a unique bio-geographic position which is in the confluence of palearctic Ethiopean, Indo-Malayan and Indo-chinese realms of fauna and possess a number of components from each of these realms. The Ethiopean region is represented by chinkara, the hyena and the ratel; the palearctic by lynx, wolf, markhor, urial and hangul; the Indo-chinese by red-panda and the mask deer; the Indo-Malayan by the hoolock and gibbon, the elephant, the goat antelope, and the mousedeer.

India along with south-eastern Asia forms a part of the oriental region. This is one of the six great geographical realms into which the earth is divided. Each of these realms supports its characteristic animal life. The Indian region has varying physical characteristics along with a great variation in climate and vegetation. Zoo-geographically India can be divided into several zones which are: (i) Malabar coast, (ii) Main peninsula, (iii) Gangetic plain, (iv) Indian desert, (v)

---

* Regent Park Govt. Housing Estate, Block X, Flat 4, Calcutta-40

Deccan thorn desert, (vi) Punjab and its semi-arid desert, (vii) Ladak and its cold desert, (viii) Assam and contiguous hills, (ix) Wooded hill slopes of the Himalays, (x) Andaman and Nicobar islands, etc.

The distinct zones are indicative of the richness of fauna of the Indian sub-continent from ecological and bio-ecological points of view. India's unique diversity in fauna stems from her ecological variations typified by hot rainless deserts, cold snowbound mountain peaks and wet and soggy rainy regions.

National wildlife action plan

It is relevant to mention here that a National wildlife action plan has been drawn by the Department of Environment. It identifies ten important phases of actions as shown under :

(i) Establishing a net work of scientifically protected areas such as national parks, sanctuaries and biosphere reserves to cover adequate geographical areas.

(ii) Developing appropriate systems of management concerning protected areas and restoration of the degraded areas.

(iii) Building up a professional cadre of personnel fully trained for the management of sanctuaries.

(ix) Providing corridors linking all the sanctuaries of a particular area or zone.

(v) Rehabilitating indigenous, endangered and threatened species of fauna and flora.

(vi) Supporting the managemet of captive breeding programmes for plants and animals.

(vii) Developing research and monitoring facilities.

(viii) Promoting support for wildlife education and research.

(ix) Revising statutory provisions providing protection to wildlife and regulating all forms of trade in wildlife.

(x) Enlisting support from and collaborating with voluntary bodies and agencies in the total wildlife conservation effort.

Threatened and endangered species

This article is not the proper place to give a comprehensive list of the threatened species of fauna and avifauna. Several species have been extinct and many others are threatened with extinction. The hunting leopard, the two horned rhinoceros and the, pink headed duck are few amongst others which have been extinct. At least seventy one species of mammals, seventeen species of amphibians and reptiles and forty seven species of birds face the threat of extinction. Apart from the vertebrates, crustaceans are also on the point of extinction and special mention in this connection may be made of the robber crab of south sentinel island.

The time is ripe for the conservationalists to devote more attention to keep alive the following species to preserve India's rich faunal diversity and take remedial measures.

Mammals—Binturong, black buck, brow-antlered deer or thamin, caracal clouded leopard, desert cat, dungong, fishing cat, golden cat, golden langur, Himalayan thar, hispid hare, Indian lion, Indian wild ass, Indian wolf, red penda, lion-tailed macaque, loris, marble cat, mouse deer, musk deer, pigmy hog, one-horned rhinoceros, snow leopard, swamp deer, urial, wild buffalo and others.

Amphibians and reptiles—Gharial, mugger, salt-water crocodile, agra-monitor lizard, green sea turtle, hawk-bill turtle, salamander, Indian egg eating snake, leathery turtle, logger-head turtle, olive black logger head turtle, viviparous toad, water monitor and many other species.

Birds—Andaman teal, bengal florican, black-necked crain, blood pheasant, narcondom hornbill, nicobar megapode, micabar pigeon, monal pheasant, lammergeur, great Indian bustard, spotted owlet, jerdon's courser and other specie Crustacea—Robber crab.

Endemic animals

The endemic species are not safe as they are confined to a very restricted habitats with long range of distribution are comparatively safer. Many species which were once wide spread have now been driven to a very limited area owing to destruction of habitats.

Species now confined to small area—Marsh crocodile, gharial, One-horned rhinoceros, swamp deer black buck, The asiatic lion, Royal Bengal tiger, white winged wood duck, the mountain quail, the great Indian bustard, the bengal florican. the spotted owlet, the lion tailed macaque, red panda, the caracal, the Indian clouded leopard, the Indian tiger, the snow leopard, the one horned rhinoceros, the wild ass, the pigmy hog, the himalayan musk deer, the black buck, the wild buffalo, the gaur etc.

Endemic species—Narcondom hornbill, nicobar megapode, robber crab, Jerdon's courser, the nilgiri langur, brow antlered deer, the hispid hare, the markhor, the nilgai tahr, the wild yak etc.

National parks, wildlife sanctuaries and other reserves

India's vast wildlife resources have suffered a wide-scale annihilation during the period from 1940 to 1970. It redound to the credit of the foresters of India that they have been able to preserve most of its fauna from being extinct in her national parks and wildlife sanctuaries. But time has not yet come for complacency. In spite of several wildlife and game preservation acts having been passed outlawing indiscriminate killing of wildlife, national parks and wildlife sanctuaries have become the main refuge of wildlife.

India should feel satisfied, but not complacent, for having saved its wildlife in entirety including those threatened in its 47 zoological parks, 52 national parks and 223 wildlife sanctuaries covering an area of about 90000 sq. km. (figure up to 31.12.79). These parks and sanctuaries are distributed all over the country covering 110 climax types, 53 sub-types, 24 edaphic types, 22 seral types and 9 degraded types.

Conservation projects for endengered species like hangul (1970), lion (1972), tiger (1973), crocodile (1974) and brow antlered deer (1981) are sincere efforts to protect some threatened species.

The national parks have been set aside for the protection and conservation of outstanding natural and plant communities, for geological formations and for scenic beauties for the enjoyment of present and future generations in a manner consistent with scientific, cultural, educational and economic purposes. The wildlife sanctuaries have, however, been set aside for conservation and management of wildlife and the protection and management of habitats.

A bonanza of diverse ecosystems

India has been gifted with myriads of micro and macro eco-types, biotopes and complex of symbiotic plant-animal relationships in several ecosystems some of which are as under :

Aquatic and marsh ecosystem (representative sites)—Kolleru pelicanry, Nelapattu bird sanctuary, Nal-sar avar bird sanctuary (all in Andhra Pradesh), Sultanpur bird sanctuary (in Haryana), Chataprava and Ranganthitoo bird sanctuaries (in Karnataka), Ghana bird sanctuary (in Rajasthan), Valangudi (in Tamilnadu) and several others.

Estuarine ecosystem (special site)—These are an asset to this country life in Sunderbans (West Bengal) and Bhittar-kanica (Orissa). This ecosystem is the most complex of all ecosystems anywhere in the world.

Lagoon ecosystem—Chilks (Orissa), Point calemere (Tamilnadu) and Pulicat (Andhra Pradesh) sanctuaries are complex sites for micro and macro plants and animals. Aquatic flora which has become a rare commodity in this country will be saved in these sites.

Volcanic ecosystem—The Barren and Narcondom islands in the Andaman group are of volcanic origin. Narcondom hornbills are endemic to Narcon-dom island only. These are some feral goats in the Barren island. A thorough study of flora and fauna in these islands will reveal more interesting data.

Desert ecosystem—The Rajasthan desert sanctuary is a unique site for the conservation of desert flora and fauna.

Marine ecosystem—India has not established more than one which in the gulf of kutch. A sanctuary is to be established in Andaman at Chidiatappu.

Scores of marine animals and plants will be protected in these sanctuaries.

Marsh ecosystem—A grand assemblage of aquatic plants and insects and birds may be found in the sanctuaries at Pakhal, Pocharam, Dudhwa, Mahavira Harina Vanasthali, Kaziranga, Lakhawa, Orang and in several other such sanctuaries.

Tropical forest ecosystem—In the tropical forests of Andaman and Nicobar islands many endemic plants and animals occur. Megapode, nicobar pigeon, Andaman teal, Andaman pig have been given protection in South sentinel, Barren, Button islands and at Saddle peak and at Mount Harriet.

Sanctuaries in various geographical zones

According to Champion and Seth two major types of vegetation cover about 70% of the forest types of India ; these are—tropical moist deciduous (30.9%), tropical dry deciduous (38.7%). Other types are—tropical evergreen (6%), tropical and semi-evergreen (2.5%), littoral and swamp (0.9%), thorn forests (6.9%), montane wet temperate (2.1%), moist temperate (3.6%), dry temperate (0.3%), and others (8.4%). Of the distribution of parks and wildlife sanctuaries, the western ghat areas have 32, the western himalayas 33, the eastern ghats 15, Bhutan and Nepal 10, the eastern himalayas 15, the Mangrove sites 3, the Indogangetic plains and foot hills 25, dry deciduous and scrub forest areas 80 and the balance in other areas 20.

Rehabiliation of endangered species (some major ones)

Crocodiles and gharial—At least 25 sanctuaries and parks offer protection to salt water crocodile, marsh crocodile and gharial. Massive breeding programmes have been undertaken to protect these reptiles. These may be seen at Manjira, Corinaga, Satkosia, Jawahar sagar, Krishna, Lanjamagadu, Chambal, Bhagabatpur, Nagarjun sagar, Guindy, Nandankanan, Katerniaghat, Amrawati Kinnersani, Manjira and at several other places.

One horned rhinoceros—This rare animal is being given protection at Kaziranga, Manas, Sonai-Rupa, Orang, Lakhawa, Jaldapara (all in India) and at Chitwan-Rapty valley (in Nepal).

Tiger—In all the thirteen project tiger areas this animal is said to be breeding to expectation. Sunderban is a unique site.

Wild buffalo—This rare animal is receiving attention in Kaziranga, Manas, Lakhawa, Garampani, and at Kutrū W. L. Sanctuaries.

Black buck—This rare animal is being given adequate protection in Taroba, Pocharam, Kewak, Bori Valavadar, Gir, Siriska, Ratapani, Panch, Kenawat, Kaimur, Tadwai, Nagarjun sagar, Tungabhadra, and Kanha national parks and sanctuaries.

Nilgai—This animal is being well looked-after at Ranthambhore, Siriska, Yawal, Jaisamad, Nawagaon, Pochamarhi, Porch, Gir, Najira and Gomardha sanctuaries and national parks.

Florican—It has a very limited distribution probably in Orang in Assam.

Mouse deer—This animal is being given protection at Molem, Dalma, Borvili, and Simlipal wildlife sanctuaries.

Wild ass--The only sanctuary where it is getting protection is in Rann of Kutch.

Musk deer—This animal is getting protection at Dachigaon, Rajparian, Chimnai, Rohru, Tundah, Talsa, Kinnarnur and Rajgarh W. L. Sanctuaries.

Ibex, Bhoral and Markhor—At the sanctuaries at Rohru, Tunda, Kugli, Kelatop and Khajyor this animal is getting protection.

Swamp deer—At Kanha, Kaziranga, Dudwa Parks this animal has been safely breeding.

Flamingo—This bird is to be seen over a limited area in Chilka and Nalsaravar.

Pelican—This bird is to be seen at Chilka, Kolleru and Nelapattu W. L. Sanctuaries.

Hangul—This animal is to be seen only at Rajparian sanctuary in Kashmir.

Narcondom hornbill—It is to be seen only at Narcondom island sanctuary.

Robber crab—In the south sentinel island this crustacea can be seen.

Brow antlered deer—Keibul Lamjao National pak in Manipur is the only home of this deer.

Great Indian Bustard—This bird can only be seen at Bustard WLS in Maharastra, Desert WLS at Rajasthan, and at Ranebennur WLS at Karnataka.

Golden langur—Only to be seen at Manas WLS and to be west of the Sanctuary.

White tiger—It no longer can be found in forests.

Outstanding features of a few National parks and Sanctuaries

Of 222 wildlife sanctuaries and national parks of the sites have special features as (i) Wide coverage of latitudinal, longitudinal and altitudinal ranges, (ii) High density of animals species, (iii) High density of individual species, (iv) Rich floral species and (v) Diversities of sites—These qualities may be found in many parks sanctuaries, but some special sites are :

Kanchanjungha national park in Sikkim—It fulfils the above qualities (i), (iv) and (v). Snow leopard, clouded leopard, binturong, red panda, tibetan wild ass, blue sheep, takin, musk deer, marble cat and myriads of insects, butterflies and moths and birds are special feature of this sanctuary.

Namdhapa WLS in Arunachal Pradesh—It also fulfils the condition as the aforesaid one.

Corbett national park—It fulfils the aforesaid requisites (ii) (iii), (iv) and (v).

Simlipal Tiger reserve—It fulfils the qualities (iv) and (v).

Kanha national park—It fulfils the qualities (ii), (iii), (iv), and (v).

Nandadevi, Kadarnath and Valley of flowers sanctuaries—These fulfil requirements (i), (iv), and (v).

Sunderbans tiger reserve—It has the qualities (ii) to (v).

Kaziranga national park—It fulfils the requirements (ii) to (v).

Bandipur-Wynad-Nagarhole and Mudumalai WLS complex—Probably one of the best sites fulfilling all the conditions.

Abundance of chital in Palamau, Kanha, Corbett and Bandipur, Sambar at Ranthanbhore, Swamp deer at Kaziranga and Dudwa, Hog deer at Kaziranga, and wild buffalo at Kaziranga are some notable features.

Wildlife Research

Research in the field of wildlife is still in the incipient stage. The study of varieties of flora and fauna, their interaction symbiotic relationship, diseases, breeding etc. offer rare opportunities for research. Few countries in the world will be able to offer such diverse opportunities.

Decline in animal species and regression

During the last few centuries the vertebrate fauna has reduced considerably. Their composition was more complex. The intensity of this impoverishment is high. There has been qualitative and quantitative decline in the number of genera and individuals. Of species leading to a high degree of regression. The degree of such regression surpasses that of faunal impoverishment.

Mean faunal regression has been calculated by Dr. A. K. Mukherjee of ZSI in his paper entitled "Some examples of recent Faunal impoverishment and regression" (1974). He has found out that the rate of regression is 90%. He used the formula $\frac{(R-r)\times 100}{R}=Q$, where Q = coefficient of faunal regression; R = size of the former distribution range in sq. km.; r = present size in sq. km.

Why conservation programme ?

Flora and fauna are an integral part of the vast natural resources which are in perfect balance with each other. Efforts are being made to create vast areas of biosphere reserve primarily for the protection of the plant gene resources. The massive human population explosion and technological innovations have upset the balance. In the conservation of wildlife, air, water, soil, and living organisms are being conserved. Innumerable plant species are also being protected. The conservation has intrinsic cultural and scientific value. UNESCO'S 'Man and Biosphere' programme is concerned with these conservation problem and conservation education. In this country the population pressure and extension of agricultural land for optimal food production have overshadowed the conservation needs. Ecological principles have not received the attention as they should get, Indiscriminate hunting and food scarcity have intensified the capturing of animals, birds, snakes, lizards, frogs and even insects for the purpose of protein food.

Fish population and other aquatic life have been also depleted owing to shrinkage of aquatic sites. However it is well to mention here that the faunal wealth in the tropical and high humid temperature condition has been responsible for creating a very stable system in our country in which climate, soil, vegetation and fauna exist in an extremely complex state of dynamic equilibrium. Wildlife which is the faunal component of the ecosystem is closely associated with vegetation. But monoculture of economically important species tends to destroy the diversity of flora and fauna.

Lack of strong policy

There has not been a clear environmental policy in this country. Of late governmental and non-governmental agencies have been involved in the protection of environment. There has not been adequate public awareness of the importance of plant and animal life, of geological features scenic beauties bearing on our national life. People should be made aware of the utility of wildlife reserves which are not luxury but a crying necessity. The introduction of wildlife protection Act of 1972 has been a strong and useful step in this direction. Wildlife acts of 1873, 1878, 1932, 1933, and setting up of Indian Board of wildlife (1952) are also bold steps in conservation effort.

A great stride in conservation effort

Of late conservation has become an integral part of all development programme in this country. Ecological consideration are being given adequate attention while undertaking all developmental works. Clear guidelines have been formulated in this regard. All planning and executing agencies have been instructed to preserve all natural resources while developing it. A separate Department of Environment has been set up which controls all environmental problems including the wildlife wing of the forestry sector.

Efforts of the state governments to conserve and rehabilitate various species of wildlife in diverse sites have been commendable. Wildlife protection laws provide severe punishment for the law breaking and poachers. Yet the lure of the rhino horns as aphrodasiac, tiger, leopard and lizard skins for high commercial value, snakes, frog, turtle and birds of protein food has induced a large group of people to take poaching. As such the final battle of conservation of wildlife is yet to be won. The guiding philosophy of development should be 'development without destruction.' □

PLANNING FUTURE STARSHIPS IN SIBERIA

V. IVANOV*

Soviet scientists of the Siberian city of Krasnoyarsk are conducting a series of unique experiments on a device named BIO. These have very important bearing not only for future, super-long space voyages but also as a model for proper organisation of biosphere on the Earth.

CAN one go on a space mission lasting for many months without leaving the Earth ? Scientists of the Siberian city of Krasnoyarsk say they can.

A day before the Soviet-Indian space crew came back home from orbit a so far unprecedented experiment also ended here. Nikolai Bugreyev and Sergei Alexeyev, two young Soviet scientists, had spent five months in an airtight device called the Bios. Experts claim that such a period of time would be needed by a spaceship to reach the Mars from the Earth and cover a third of the distance on its way back.

Launching of the Experiment

The experiment was launched on November 11, 1983 at 14 hours Moscow time, as Nikolai and Sergei entered the Bios camera having a valume of 300 cubic metres. A thick metallic door was locked behind them and sealed, so that nobody could intrude and disturb the researchers isolated from the rest of the world. It was decided that the door would be opened only in case of emergency. The only things the two inhabitants of Bios were getting from the outside world were electricity and TV broadcasts. During the last few days spent in the camera they developed a keen interest in televised reports from outer space covering the Soviet-Indian joint mission. "Of course," Nikolai and Sergei admitted later, "we sort of envied the real cosmonauts, but we knew there were a lot of reasons for which they could envy us, too."

For many years now the staff of the Krasnoyarsk Institute of Biophysics of the USSR Academy of Sciences, Siberian branch, has been conducting research into problems pertaining to the Earth's biosphere. Some results have been very impressive and won the Institute international appreciation. Siberian scientists conduct a large amount of research to solve the problems related to long staying of man in outer space, that is in a closed habitat. The first researches on the above problems started here in 1961, right after Yuri Gagarin's first flight into outer space. Academician Sergei Korolyov, the chief designer of all Soviet space vehicles at that time, was always interested in the results of research. A long chain of experiments had resulted in the development of a rare apparatus named Bios meaning "life". While living inside the device for various time periods, scientists got the opportunity to learn to provide themselves with vegetable and grain foods and all other components required for a normal life.

Several varieties of wheat and vegetables are grown here on special plantations known as phytotrons. During the first few experiments, vegetable and grain foods made 30 to 40 per cent of the researchers' daily rations. In the last experiment ended on April 10 the share was doubled.

Based on substance Cycle

Commenting on the nature of the experiment, Joseph Gitelzon, Alternate Member of the USSR Academy of Sciences in charge of the project, said : "Our work is based on the principle of substance cycle in Nature, the chief mechanism that enables man to live on the Earth. Our experiments are fundamental and directly related to space flights. But we do not focus on prolonged space flights over large distance alone. Our experiments have a general biological implication, which has helped us arrive at a sad conclusion that life on the Earth has not yet been organised properly. There are yet a lot of tensions, in some parts they result from overpopulation, in others —from bad crops, etc. Meanwhile, Nature alone is not to be blamed for that. It appears extremely important to us to learn to use the Nature whose potential is virtually unlimited. For example, in the Bios we can reap in up to six harvests of wheat per year. Yet this is by far not the only thing that Bios can help us do. Our methods for fast growing of grain and vegetable crops are being used by the leading selectionists of the country for developing new varieties. One should realise that mankind is facing the task of thoroughly studying the substance cycle and learning to control it."

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* APN Correspondent

Nikolai Bugreyev, for one, has spent altogether 13 months in isolation, including the Bios experiment. Cheerful and energetic, he talks willingly about his impressions and compares his previous experiments with the one that has just been over. During the previous experiments in Bios, the researchers had 13 square metres of arable land per head. In the last experiment the space was doubled. As yields went up, daily rations improved to include new products, such as peas and turnip-rooted cabbage.

"It's the first time I have been involved in such an experiment," said Sergei Alexeyev. "I hardly noticed how time passed. We had a lot of interesting work to do, so we did not use simulators as a cure against hypodynamy. We did not have them at all. We just worked. Apart from medical examinations of ourselves, we had to take care about plants, reap in harvests, bake bread, cook various dishes of plants and products that we had taken along. We were also writing diaries and reading much. Sometimes we were allowed to talk with our relatives. Although we were constantly watched by physicians, their interference was not necessary. Both of us revealed a good psychological compatibility and an ideal health."

Nikolai and Sergei invited this correspondent to enter the Bios. The first thing I felt when I came in was the fresh air full of ozone blowing in a light breeze. It was as if I was walking across a field on a fine summer day just after rain. In the dwelling premises there are two well-appointed single compartments, a kitchen-cum-dining room and an armchair. Siberian scientists are of the opinion that future starship will be fitted out in a similar way to lessen psychological tensions of the crew and enable them to endure a long separation from the Earth. ☐

THE WORLD PREPARES TO MEET HALLEY'S COMET

B. B. BALIGA*

SINCE the last several years, man, the world over, is preparing to meet and probe Halley's comet which is coming very close to the Earth in 1985-86. The scientific community all over the world is united in this common purpose and hopes to understand more about such objects which stray into our solar system. The origin of these is still unknown.

Comet Halley was last seen in the sky in 1910 and it comes every 76 years, quite close to the Earth. Man has made much progress in these 76 years, both in science and technology. Thus the preparations are rather elaborate. The Soviet Union will launch on December 15, 1984, the first of the space probes to intercept Halley's comet in March 1986. The first Soviet Space craft Vega-I will be followed six days later by an identical spacecraft Vega-II. Japan plans to launch two identical space probes on January 5th and August 14th, 1985. The European Space Agency's Comet Halley probe—Giotto will go up on July 2, 1985.

The Soviet Union is launcing its probes a bit early because they will pass Venus on their way to the comet. Originally these probes were intended to probe planet Venus and were similar to the long line of successful Soviet probes to that planet. Remember the Venus-13 and 14 crafts that took the first colour photographs of the planet surface, back in 1982 and Venus-15 and 16 crafts that have been orbiting around Venus for over a year now ?

Originally aimed to explore Venus, the Soviet astronomers realised that the main space craft after passing Venus would come to Halley's comet, after it had circled the Sun one and a half times. The scientists, therefore, altered the mission to include both Venus and Halley's comet (the name Vega is a contraction of Venus-Halley : the letter H transliterates into Russian as an aspirant 'G'). This Rs. 140 crores pair of Vega probes mission involve many of the European countries besides the Soviet Union. They are Hungary, Poland, Czechoslovakia, Bulgaria, East Germany, Austria, France and West Germany.

The two crafts are scheduled to be launched on the Soviet Proton rockets in this month and will reach Venus on 14th and 15th June next year. As the main probes pass the planet they will drop a lander craft which will release a balloon as it descends into the thick clouds of Venus. The balloon, which is expected to survive about two days, will provide new data on the hot and dense atmosphere. The landing craft itself will descend by a parachute from a height of 60 km, taking measurements of the atmosphere on the way down. On reaching the ground it will investigate the composition of the surface by irradiating it with x-rays and gamma-rays (activation analysis of the soil). One may recall that the American Pioneer probe had indicated that Venus had active volcanoes and the Vega results are expected to increase our understanding of volcanism of Venus by correlating the surface composition analysis with topography revealed by radar.

The present craft which will pass Venus at a distance of 30,000 km, will use the planet's gravitational field to pull them into a new orbit, which will take them beyond the orbit of the Earth before meeting comet Halley in March 1986. As Vega-I will be the first probe to reach the comet, Soviets have agreed to release the data that it gathers immediately to other countries involved in Halley's mission. This is especially important to the European scientists whose probe Giotto will be aimed at the nucleus of the comet, which is hardly a few kilometers across and it is not possible for the telescopes on the Earth to see it directly. The information on Vega-I which will pass the comet at a distance of 10,000 km, will allow

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European scientists to redirect Giotto to within 100 km of the nucleus, the final correction to be made in the orbit just two days prior to its encounter with the comet.

Each Vega craft which will fly-past at a relative speed of 78 km/sec, is sturdily built to withstand the impact of particles of dust in the comet's gaseous head. The rather large solar panels are capable of providing power for all the instruments during the probe's rapid fly-past. The camera platform of the crafts can swivel to watch the comet in its flight. Besides several instruments on the craft will investigate the comet's dust and gas. A novel dust counter will record the amount of dust simply by hearing the impact of dust particles on a special plate. Another instrument will measure the composition of the plasma which results when the high speed impact vapourises the dust. The Vega crafts are also equipped with instruments to measure the comet's magnetic fields, low frequency radio waves generated in the field and the composition of the comet's gases.

Some more details about the instruments on board these two crafts is available. Mounted on the camera platform are a pair of identical telescopes each with a mirror 14 cm across, which will feed radiation to two complementary instruments. One of them will look at the spectrum and at the polarisation of light from the comet's nucleus which will enable to study the light reflectivity from the dust particles and to measure the speed of emission of various gases from the nucleus. The second telescope will focus the radiation on to an infra-red detector and allow the astronomers to estimate the temperature of the comet's nucleus, the dust streaming away from it and may provide information on some of the molecules emitted by the nucleus.

The two cameras on each platform will send back the first ever close-up images of a comet's nucleus. The wide field camera sees a region about 4° across ; this is about eight times the apparent size of the Moon seen from the Earth. The pictures are expected to give a good view of the comet's gaseous head (also called coma) and it will reveal the position of the nucleus in the head. This camera's view will then guide the platform so that the narrow field camera with a view only of 0.5° across, can look directly at the nucleus ; this camera should see details as small as 200 m across on the surface of the nucleus. As the camera is equipped with different filters, it will be possible for the astronomers to combine the various images and construct a unified colour picture of the centre of the comet.

The analysis of the data from the first craft will be utilised by the Soviet scientists to swing Vega-II closer to see finer details in the nucleus. If Vega-I finds little problem with impacts from dust at a distance of 10,000 km it will be possible to manoeuvre Vega-II to within 3000 km, which will enable it to resolve details in the cold nucleus only about 70 km across.

The day before Vega-II's encounter with the comet, two Japanese crafts will be simultaneously probing the comet from a considerably longer distance. Like the Soviet ones the two crafts Japan plans to send are externally similar : each weighs 150 kg and will spin once every 12 seconds in space. The first one to be launched on January 4, 1985 is MS-T5 which is mainly to test their rocket—the M-3S2—the probe's own small rocket, its communication systems to control the probe's attitude. The experience gained will be fed in preparing the second launching with the probe—Planet-A in August 1985. However, both will have its rendezvous with comet Halley on the same day in 1986. Since a single probe will not be able to carry all the equipments that the Japanese scientists want to use in studying the comet, the MS-T5 will carry a magnetometer, a low frequency receiver to investigate radio waves in the surrounding plasmas, and a detector to study the solar wind. The MS-T5 will approach just about 4 million kilometers to the comet and will investigate how the solar wind down stream of the comet is perturbed by the presence of Halley's comet. It will be possible to compare data collected with that obtained at the end of March 1986 from NASA's international comet Explorer that is expected to pass 30 million km downstream of Halley's comet. The Planet-A probe will carry a more sophisticated vacuum ultra-violet camera and will pass much closer (200,000 km) from the sun-facing side of the comet. It will take ultra-violet pictures of the nucleus of the comet. The plasma energy spectrum analyser will measure the three dimensional distribution of ions and electrons of the solar wind as well as those emitted from the coma of the comet.

European Space Agency is sending its own mission Giotto which is expected to fly right into the comet's centre. However, as stated earlier, in-orbit manoeuvring will be necessary with proper feed-back data from Vega-I. If everything goes on well Giotto may reach within 100 km of the nucleus and transmit a lot of information about the nucleus for the first time. The astronomers are confident to collect a lot of information from this time's apparition as all the missions, though from different countries and groups, are complementary rather than competitive. The cooperation and coordination which is good so far is expected to continue till the end.

Edmund Halley, after whom the comet is named, might never have thought in his wildest fancies that the bright object that he observed in 1682 would bring him fame over the centuries. Its appearance every 76 years just renews this memory. However, with its determined regularity and checking with the available astronomical records, this has been traced back to as early as 66 A.D. It should be noted that these were all naked eye observational records.

The highly elliptical path of comet Halley around the Sun carries it well beyond Neptune's orbit to just within Venus'. The comet's orbital plane is inclined 18° to the Earth's and its motion is retrograde (in the opposite direction from the planets). Thus Halley's orbit lies near our own for an extended interval before and after perihelion (the comet's closest approach to the Sun). In more than a third of its apparition in the past 2000 years, comet Halley passed within 0.2 astronomical units (about 30 million km) of the Earth. This is the reason why the visitor had been so well documented throughout all the history.

On the basis of the geometrical circumstances of past Halley apparitions, experts on comets divide the encounters into three broad catagories : Type I : The comet comes closest to the Earth on the inbound leg of its orbit several weeks before perihelion. It first becomes visible as a slowly brightening object in the morning sky far removed from the Sun. At such returns the comet lies at far northern declination and is very well placed for observation from the Earth's northern hemisphere. Following the comet's closest approach, it moves into the Sun's glare where it typically remains until has faded well beyond the naked-eye threshold. Type II : Closest approach to Earth occurs within a few weeks of perihelion. In this case Halley usually appears rather suddenly in the morning sky bright and fully developed. It then falls back rapidly towards the Sun and reaches conjunction well north of it. Becoming an evening object, it quickly attains maximum eastern elongation. As the comet fades it all descends into the evening twilight and is lost. Type III : Halley passes closest to the Earth some weeks after perihelion. At first it is on opposite side of the Sun as seen from the Earth, and its approach is hidden from view. No naked-eye observations are possible until a week or two following perihelion passage. Then suddenly Halley rises out of the morning twilight, bright and sporting a long tail. The comet's track across the heavens strongly depends on whether closest approach occurs inside or outside the Earth's orbit. In the first case the comet will return to conjunction with the Sun and will reappear as an evening object. In the second case it will drift from the morning sky and into the evening sky.

Either kind of type III apparitions is far more spectacular than type I or II. Approaching the Earth the comet becomes brilliant. Its huge dust tail, subdued before perihelion, stretches scores of degrees across the sky. Unfortunately the type III appearances occur in the springtime in the northern hemisphere, where twilight often can be a serious hindrance.

The current apparition of comet Halley is unique ; it closely resembles type III, but does not fit neatly into any of the three types. With the perihelion occurring on the far side of the Sun, the 1985-86 apparition will result in two moderately favourable passages by the Earth instead of only one. The first on the comet's inbound leg will favour the northern hemisphere observers. The second with the comet's outbound and somewhat closer to the Earth, will be a southern hemisphere event.

What do we know about comets ? We know that the cometary activity is transient. It gets bigger, brighter and develops tail as it approaches the Sun. It is at its full glory when it is closest to the Sun. It fades as it recedes from the Sun. The material in the tail of the comet must come from the core of the comet which is called the nucleus.

It is believed that the nucleus of the comet consists mostly of frozen gases, such as H, C, N, and O and frozen water molecules mixed with dust (silicate particles). The solar heating liberates the frozen gases and dust which expands outwards in spherical form (called coma) and extends upto 10^5 km. The dust particles in this cloud reflects solar radiation and makes it visible. Surrounding the coma is a halo of hydrogen gas extending upto 10^7 km. Ultra-violet sensitive instruments can easily spot it. Solar radiation which exerts pressure on the dust particles pushes them away from the Sun which gives rise to a tail. Solar radiation is also responsible for breaking the original molecules released by the nucleus and ionises them. These charged particles are swept out of the solar wind (stream of charged particles coming out of the Sun) and a second tail called plasma tail is formed. The characteristic light emitted by the ionised gases makes visible the plasma tail which extends upto 10^7 km. Thus every time a comet enters the solar system the nucleus looses material which is finally dispersed into the solar system.

The origins of the comets is not fully understood. However, the spectroscopic data supports the hypothesis of solar origin. It is believed that they were formed at the same time as the Sun and the planets. Thus studying the material of the nucleus of the comet it may give a clue to the original solar nuclear material. There are other questions too to answer, especially about the spin. It is hoped that in the 1985-86 apparition many of these questions will be answered as the direct probe can go quite close to the nucleus of the comet.

It should be remembered that during the 1910 apparition of the comet Halley the British scientist, Evershed had taken a number of photographs of the comet from the Indian soil at the Kodaikanal observatory. These valuable photographs are still used as a guide for the comet's imminent apparition. Besides, several volumes of data collected at that time are presently available at the Hyderabad observatory.

In July of this year a two days workshop on 'Observing of Comet Halley' held at the Indian Institute of Astrophysics, Bangalore coordinated the Indian efforts. The scientists directly involved in the observation of the comet met and discussed their research and explored the possibility of cooperative programme. The forty odd participants came from various institutes, observatories and universities. Studies will be carried out by the three major observatories in India, namely the Indian Institute of Astrophysics in Bangalore, Osmania University in Hyderabad and the Utter Pradesh State Observatory at Nainital. These will be supplemented by the observations carried out at the Punjab University in Patiala and the Positional Astronomy Centre in Calcutta. The three observatories mentioned earlier will also make available the data about the position of the comet (measured by photographing it at regular intervals) to the scientists in the USSR and in exchange will get the scientific information on the comet collected by the two space probes.

India will also collaborate in the International Halley Watch (IHW) set up by the National Aeronautics and Space Administration (NASA), USA, for coordinating the various obsevations. This worldwide network of observatories is to make observations to cover the entire orbit of the comet as it approaches and recedes from the Sun. Indian observatories will be critical in this link as there are no other observatories in this region. The membership of IHW (professional and amateurs) has risen from 875 to 1295 in 47 countries. Thus IHW will be a focal point for exchange of information, discussion of common problem and mutual support to enhance the overall scientific returns from various space missions to the Halley's comet. It is in fact, the global effort to explain Halley's comet as completely as possible during its present apparition. ☐

RADHA GOBINDA CHANDRA—AN ASTRONOMER, UNRECOGNISED IN HIS OWN COUNTRY

RANATOSH CHAKRABORTI*

IT is strange to think that a petty clerk of a Govt. Office every day after his day's hard toil is observing the stars and planets of the night sky. But it is true in the case of Radha Gobinda Chandra, originally a podder (coin tester) of a collectorate office whose astronomical observations were once widely appreciated by the astronomers of Europe and America.

Radha Gobinda Chandra was born in 1878 at Bagchar of Jessore, now in Bangladesh. He was brought up in his maternal uncle's house. His academic career was short and simple. He did neither acquire any university degree, nor go to any college. Surprisingly, he did not even pass the Entrance Examination. At the age of 21 he joined the district collectorate of Jessore as a podder with a monthly salary of rupees fifteen only.

Although he had shown nothing bright in his early academic career, Radha Gobinda was a serious reader at home. He utilized fully the academic atmosphere of his maternal house. In his boyhood he read a book—"Brahmanda Ki Prakanda" (How vast is the Universe) edited by Akshoy Kumar Dutta, which made Radha Gobinda to take a keen interest in the sky. Moreover, Kalinath Mukhopadhya, a pleader of Jessore and an amateur astronomer drew him nearer to astronomy. Consequently, Radha Gobinda, with the help of a simple binocular and naked eye started to observe the celestial bodies. Meanwhile, in 1910 Halley's comet appeared. Radha Gobinda took the opportunity, and he published two articles in Bengali about the comet in a magazine "Hindu". At that time he came into contact with Jagadananda Roy of Santiniketan, who suggested that he should collect a telescope. Radha Gobinda purchased a three inch refractor telescope from London at the cost of Rs. 257 and 6 paisa. Now, with great enthusiasm he started his astronomical observations and came in touch with the astronomers of Europe and America.

His life-long researches were wide spread in various astronomical phenomena, like variable stars, occultation of stars, nova, meteors, eclipses and so on. But most of his contributions to foreign journals were on variable stars. His outstanding contributions in the field of variable stars helped to a great extent in the classification of variable stars. Adequate reference of which are in the abstracts of Astronomy and Astrophysics and also in the books and journals.

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Radha Gobinda was the first, not only in India but in Asia, to observe a new star on June 7 of 1918 in Aquila constellation.

From the remnants of his old records, it appears that astronomers of Western countries attached great importance to the observations made by Radha Gobinda. One of the letters written from Harvard College Observatory on January 17, 1920 states—"The observations which you contributed are very good and we hope you will continue to send them each month". Similarly, the secretary, AAVSO (American Association of Variable Stars Observers) on May 29, 1920 wrote to Radha Gobinda : "Thank you very much for the splendid list of observations of variable stars, which you have been sending to the AAVSO". A letter from British Astronomical Association dated the 27th Dec. 1923 states—"Your excellent observations and remarks are always much valued by this section, and I hope we may continue to enjoy your hearty and enthusiastic support". Besides this, Harvard Observatory published his photograph in their publication which can still be seen at his last residence at Barasat, near Calcutta. Moreover, to help him in his observations, Harvard Observatory presented him with a 6½' reflector telescope in the year 1926 which was sent to Bagchar, all the way from America. Soon afterwards, the Education Department of France honoured Radha Gobinda Chandra by confering on him the honourable title of "Officer d' Academic Republique Francaise". The title and a medal were forwarded to Radha Gobinda by the Consulate General of France at Calcutta on 1st August 1928. In recognition of the merit of his scientific observations, British Astronomical Association, Harvard College Observatory; Lyon Observatory, France ; American Meteor Society ; American Museum of Natural History, offered him membership, and he accepted their offer. In 1950, 12th Dec. the Harvard Observatory wrote a letter of appreciation to Radha Gobinda, a part of which is mentioned here : "The American Association of Variable Stars Observers, with headquarter at the Harvard Observatory is honoured to salute you as one of its important contributors from abroad."

At the fag end of his life when Radha Gobinda could no longer take observations, he approached individuals and organisation to be the custodian of his telescope mentioned earlier. At the instance of the Harvard Observatory, the telescope was ultimately handed over to late Dr. V. Bappu, the then Director of the Indian Institute of Astrophysics, Bangalore. It is however, not known whether the telescope which contributed so much in the observation of variable stars through the meticulous efforts of Radha Gobinda in the past is still in operation in one of our Indian Observatories.

Apart from all these, Radha Gobinda should also be remembered in our country for his outstanding contributions to the Calendar reformation movement, on which he published some valuable articles. He was actively associated with this movement, but detailed history of his contribution is not available.

He wrote some popular books on Astronomy but only one of them on comets ("Dhumketu" in Bengali) was published and perhaps is one of the authentic books on the subject—the rest are till in manuscript form and deserve consideration for publication.

Radha Gobinda is no longer with us. He died at the age of 97 on 3rd April, 1975. It is unfortunate that no serious attempt has so far been made to explore the complete works of Radha Gobinda Chandra. Although his life should serve as a beacon light to every serious voyager in the domain of science and knowledge. □

Nobel Prizes : 1984

PHYSICS

Nobel prize for 1984 in Physics has been awarded to Carlo Rubbia and Simon van der Meer jointly, both from the CERN for their decisive contributions to the large project which led to the discovery of the field particles W and Z, communicators of the weak interaction.

They, by their discovery, confirmed the unification of electromagnetism and the weak nuclear force. The formulation of the theory of weak force before 50 years by Fermi opened a new era in nuclear physics. Attempts to unify weak force with the electromagnetism theoretically are recent and the electroweak picture formulated by Sheldon Glashow, Abdus Salam, Steven Weinberg through the gauge theory earned the Nobel award in Physics for them in 1979. The theory predicted the existence of the particles $W^{\pm}$ and Z^{o} of masses 83.0 ± 2.9 Gev and 93.8 ± 2.5 Gev respectively. To find these particles is not a trivial task, since it would require a very high energy accelerator, not existing in any laboratory. It was not very strange when a renowned experimentalist remarked on the award of 1979 Nobel award that 'Are they going to give back the prize, if these particles are not found ?'

Thanks to the proton-antiproton collider at CERN which produced these particles in 1983.

Rubbia was the driving force of the experiment at CERN. In 1976, he proposed the Fermilab authorities in USA to modify their accelerators to proton-antiproton collider. The proposal was faced some disfavour. At CERN, the idea was favoured by the then Research Director-General Leon Van Hove and the Executive Director-General Sir John Adams. During 1976-80, the term of their office, they had the crucial roles in pushing the Antiproton project at CERN.

The concept of colliding beam to avoid the knock on energy loss by head on collision into one another is a bold step for energy increase in accelerator technology. Electron-positron colliding beams with the same magnet in Orsay by Bruno Touschek and at Stanford by Richter were the pioneer experiments in this direction. The team led by Kjell Johnson at CERN built the Intersecting storage rings (ISR) for two proton beams. From the positron-electron collider experiment, it was obvious to apply the technique for proton-antiproton collision in the same magnet ring in which particles circulate in mutally opposite direction. But the difficulties in producing intense antiproton beam make the experiment nearly impossible. The invention of stochastic beam cooling by Simon van der Meer made it possible for such intensification of antiprotons. In 1972, his first report on this technique applied to ISR was published in which he presented some quantitative estimation of the effect based on his observation. In a final test in, 1974, carried out in the ISR, it was enough to show that the idea of beam cooling, i.e. the reduction of the spread of particle energies around a desired value had succeeded. During 1976-77, a storage ring at CERN was converted to test the cooling technique and was renamed ICE—Initial cooling Experiment. The rasults of the experiment obtained in 1977-78 were encouraging. Meer was responsible for inventing and applying the technique to the CERN super-proton synchrotron successfully to obtain an intense antiproton beam, which was the key to the experiment leading to the discovery of W and Z.

Carlo Rubbia was the driving force who conceived the experiment and its over-all scenario in 1976. He was responsible for conducting a large team consisting of hundreds of people involved in the CERN super-proton synchroton experiment leading to the discovery of W and Z. The team consisted of 130 physicists from 13 research centres—Aachen, Annecy LAPP, Birmingham, CERN, Helsinki, Queen Mary College, London; College de France, Paris; Riverside, Rome, Rutherford, Saclay, Vienna and Wisconsin. Use of the 270 Gev proton collider to produce 540 Gev energy by proton antiproton collision and carrying the collision experiment in UAI code named after underground area in the excavated large cavern, was the responsibility of Rubbia. The Antiproton accumulator (AA), a storage ring for producing stochastic cooling for intense antiproton beam devised by Meer, was soon constructed by Roy Billinge and his team. In 1978, another collision region UA2 was approved in collaboration with fifty physicists from Bern, CERN, Copenhagen, Orsay, Pavia and Saclay led by Pierre Darriulate.

In February 1981, the proton synchrotron at CERN accelerated antiprotons from the AA. At a Topical Workshop on proton Antiproton collider physics' held in Rome from 12-14 January 1983, evidence for observation of W particles by UA1 and UA2 collaborations was announced. A few signals out of several thousand million proton antiproton collisions corresponded to the W particles decaying into an electron (or positron for W^+) and a neutrino. On January 20, Rubbia reported six W events in UA1 and Luigi Di Lella reported four such events in UA2 tentatively. Rubbia was more convinced to comment "They look like W's, they feel like W's, they smell like W's, they must be W's". On January 25, 1983, they reported their discovery in a press conference with an estimate of mass about 80 Gev in excellent agreement predicted by the electroweak theory. The theory predicted the production rate of Z lower than W by nearly ten times. So the physicists had to push the collision rates higher to detect the decay product electron-positron pair or muon pair of Z. Success was achieved in no time and the discovery of Z was announced on June 1, 1983 with its estimated mass nearly 90 Gev in line with the theoretical prediction.

By the discovery of W and Z particles, which are bosons in character, man arrived in his quest to a crucial point to understand the universe. It is a step forward to the still undiscovered Grand Unification Theory, which assumes unification of the four forces namely gravitation, nuclear, weak and electromagnetism in the moment of bigbang creation of the universe.

The discovery of W and Z is ranked among the greatest achievements in the history of science. It has been made possible by high technological excellence and a team work unparalleled in the area of pure research.

All the credits of the discovery go to Meer and Rubbia for which they are recognised with the Nobel Award for 1984 in Physics. Rubbia is 50 and is a professor in the Harvard University along with his responsibilities in the CERN laboratory. He was born in Garcia in Italy. His father was an Electrical Engineer. Rubbia had hobby for electronics in his boyhood, which helped him in his scientific career.

Meer was born in 1925 in Hague, educated in Engineering in Delft. He worked in the Phillips Company in Eindoven for sometime in electron microscopy. Since 1956, he is in CERN and has specialised in accelerator Physics. ☐

S. B. Karmohapatro

CHEMISTRY

Prof. Robert Bruce Merrifield of Rockfeller University, New York City, U.S.A., has been awarded the 1984 Nobel Prize for Chemistry. The Prize Committee in their citation have stated that Prof. Merrifield has been honoured for his outstanding contributions in the fields of solid phase chemical synthesis.

Merrifield started this work in the early sixties with regard to the synthesis of peptides. But long before Merrifield, scientists had tried to synthesize proteins in the laboratory. The steps they followed were: (i) protection of amino acid carboxyl group, (ii) formation of peptide bond, (iii) selective removal of the amino terminal protecting group, (iv) elongation of the peptide chain by repeating steps (ii) and (iii); and finally (v) removal of all protecting groups. This strategy is known as stepwise elongation.

Peptides, as we know, are amino acids linked by chemical condensation of the amino group and the carboxyl group. In a liquid phase synthesis of these peptides is started with the initial amino acid with its amino terminal group protected. Then the second amino acid with its group protected is added and reacted with the first one under special conditions. This mixture, now contains the dipeptide and the unreacted amino acids. The dipeptide in the next step has to be isolated from this mixture, before it is used as the starting material for the tripeptide stage. Thus, it is seen that this type of synthesis would involve many difficult steps of isolation and reaction to synthesize a large peptide. The loss of material in each step would accumulate significantly. Till 1963 all these reactions had to be carried out in appropriate solvents and the products at each stage had to be purified by crystallisation.

In 1963 Merrifield introduced a new concept in the synthesis of peptides known as "Solid phase peptide synthesis". He suggested that the first amino acid be chemically bonded to a polymer and the peptide synthesis be carried out using the polymer support. In the early experiment, sytrene polymer beads with chloromethyl groups as cross linking groups, were used. The first amino acid (actually the terminal amino acid of the proposed peptide chain) was attached by its carboxyl group to the reactive site. The second amino acid with all but one of its reactive groups protected was activited and coupled to the first amino acid, leaving the protected dipeptide firmly bound to the support. When the desired peptide has been synthesised, it is liberated from the solid support. The solid could be filtered and washed thoroughly in each step. An automated process at the press of a button or control valve could remove all the excess reagents and any byproducts without the slightest loss of the desired peptide.

In 1963 insulin, a small protein with two peptide chains of 21 and 30 amino acids was synthesized in Germany, USA and China. In 1965, the same protein was synthesized in Merrifield's laboratory using automated solid phase peptide synthesizer.

Several peptides and nucleic acids have been synthesized using this method. It is to be hopped that molecules related to insulin would be prepared in the near future which may exhibit greater activity for the treatment of diabetes. It may also be possible that more efficient synthetic enzymes may be found.

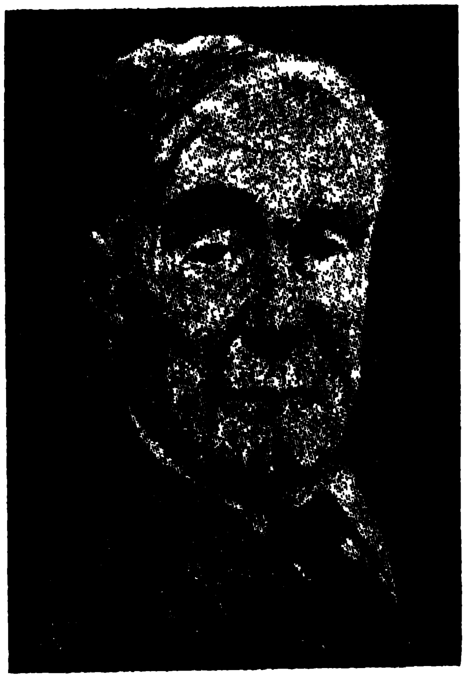
Merrifield was born on July 15, 1921 at Fortworth, Texas. He got his Ph.D. from California University, Los Angels. He is very fond of gardening. When he was told of his Nobel Prize award, he remarked 'I can now spend the rest of my life in gardening'. ☐

RabinBanerjee

OBITUARY

PJOTR LEON IDOVICH KAPITZA

With the death of the renowned Soviet Physicist Peter L. Kapitza on April 8, 1984 the world of science lost its one of the great exponents and thus has suffered a severe loss.



Pjotr Leon Idovich Kapitza

Kapitza was born on July 9, 1894 in Kronstadt in Russia. His father was a military engineer and his mother worked in higher educations and folklore research. Kapitza graduated from the Petrograd Polytechnical Institute in 1918 and was a Lecturer there till 1921. There he began his scientific career in Joffe's section of the electromechanics department by proposing a method jointly with N.N. Semenov, for determining the magnetic moment of an atom interacting with an inhomogeneous magnetic field. The method was the basis of the celebrated stern-Gerlach experiments in a later period.

In 1921, Kapitza joined the Cavendish laboratory at Cambridge University to work with E. Rutherford. There is a story about his admission to the group of students of Rutherford. At the first instance when Rutherford refused to accept him, he asked how accurate Rutherford's measurements were. The answer was that they were accurate to about 3%. Then Kapitza's arguments were that by admitting one more student, the charge of his total number of research students will be less than the margin of his error in measurements. Rutherford had, at that time, a galaxy of a large number of Researchers under him. With such witty argument of Kapitza, Rutherford is said not to hesitate any more to include him in his laboratory. Another story goes like this that Kapitza was in a contingent of Russian Scientists visiting Europe when he came to Cambridge to buy a precision galvanometer. There he met Rutherford who was so impressed with his ideas that he offered him a place in the Cavendish Laboratory. Rutherford had ability of quick grasp of genius of a person in a first contact, through which on a similar occasion he could recognise Niels Bohr in 1921 and offered him a Readership in Manchester.

In 1923, Kapitza made here his experiment to observe the bending of alpha particles in a cloud chamber placed in a strong magnetic field. In 1924, he devised method for producing very strong magnetic field and produced field up to 320 Kilogauss (32 Tesla) in a 2 ml volume. In 1928, he discovered that metals placed in a strong magnetic field have varying resistance depending linearly on the variation of the magneticfield. In 1923, he received his Ph. D. from Cambridge. Later on, he became Director of the Royal Society Mond Laboratory at Cambridge and a Fellow of the Royal Society.

In his last years in Cambridge, Kapitza turned to low temperature physics research. In 1934, he developed an apparatus for liquifying Helium based on the adiabatic principle. The same year Kapitza returned to Moscow for a short visit, but was not permitted to leave again until 1965. At this stage, Rutherford published a letter in the *Times of London* on April 29, 1935 urging the Soviet Government to permit Kapitza to work in Cambridge to enable him to choose the environment in which he can most effectively utilise the special creative gift with which he is endowed. Rutherford concluded the letter thus. 'It would be a tragedy if these gift were rendered sterile by failure to grasp the psychological situation'. The full text of the letter was reprinted in *Science and Culture* in June, 1935 (p. 44) with an editorial note supporting Rutherford and appealing to the Soviet Government, on behalf of the Indian scientists, to allow Prof. Kapitza to come to Cambridge and continue his researches there.

Perhaps the appeals were effective to some extent. Though Kapitza was not allowed to come to Cambridge, even then his equipments in the Cambridge Mond Laboratory were purchased at cost by the Soviet Government for an institute created for Kapitza in Moscow. In Moscow, with these equipments, he organised a new research institute, namely Institute for Physical problems, where his main lines of research were low-temperature physics and strong magnetic field. He was there active till 1946 when he is said to have acquired some disfavour of Stalin and was kept as a home detenu until Stalin's death in 1954. Again, he resumed his affiliation with the institute for physical problems.

In 1920's HeII was invented. In 1932, Keesom and Clusius at the Leiden Laboratory found an anomaly in the specific heat of Helium known as the lambda point. Three years later, Keesom and his daughter observed the extremely high thermal conductivity of HeII. The year 1938 volume of *Nature* published nearly 141 theoretical and experimental papers on HeII which was very unusual. This indicated how intense was the interest of the Scientific community on this fluid. Kapitza in Moscow, Allen and Misener in Cambridge, independently published the same year in *Nature* reports on the negligibility of the viscosity on HeII. Kapitza mentioned that HeII has the viscosity 10,000 times less than gaseous hydrogen, the least viscous fluid known at that time. Kapitza called Helium below the lamda point to have a special state or it is superfluid. The discovery of fountain effect in HeII by Allen and Harry Jones was based on the findings of Kapitza, Allen and Meisener.

Fritz London suggested that the superfluidity of HeII could be explained in terms of Bose-Einstein condensation as it is in a macroscopic quantum state. Kapitza experimented on the properties of HeII indicating it as a quantum fluid with zero entropy. In a series of brilliant experiments, Kapitza proved that in HeII, a new kind of internal convection occurs in which a normal fluid transport the heat and a simultaneous superfluid flow takes place in the opposite direction. Later, he discovered microwave generator of high power and a new type of continuous high pressure plasma discharge with $\sim 10^6$ K electron temperature, an indication of a thermonuclear energy generator.

In 1938, while Kapitza was studying HeII through his novel experiments, Landau, a renowned Soviet theoretician, had been in jail. Kapitza could convince Stalin to release Landau and Landau, when freed developed the theory of liquid Helium recognised by 1962 Nobel prize.

It was a surprise to the world of science that Kapitza had to wait till his old age to be recognised by 1978 Nobel Prize. In the award, the Nobel Committee cited that Kapitza discovered ideas and new techniques that have been basic to the modern expansion of the science of low-temperature physics.

Kapitza was a Clerk Maxwell student of Cambridge University during 1923-26, Assistant Director of Magnetic Research at Cavendish Laboratory (1924-32), Messel Research Professor of the Royal Society in 1930-34 and Director of the Mond Laboratory during the same period. In 1935, he became the Director of the Institute of Physical Problems.

In 1957, he was elected a member of the presidium of the USSR Academy of Sciences. He was one of the founders of the Moscow Physics Technical Institute and was head of the low-temperature physics department in that institute.

He was the editor-in-chief of the *Journal of Experimental and Theoretical Physics* and was a member of National Committee of the Pugwash movement of scientists for peace and disarmament.

Kapitza received eleven honorary degrees and was elected to membership of numerous academies which include USSR Academy of Science, the Royal Society of London (1929), the Royal Danish Academy of Sciences and letters, the U.S. National Academy of Sciences, the Royal Netherland Academy of Sciences and the Indian Academy of Science (1948).

In his life time, Kapitza received numerous awards which include the USSR state prize, the title of Hero of Socialist Labor, the highest distinction of the USSR, the Order of Lenin six times, the Faraday Medal of the Institute of Electrical Engineers, the Franklin Medal of the Franklin Institute, the Lomonosov Gold Medal of the USSR Academy of Sciences, the Rutherford Medal of the Institute of Physics, London, and Sir Debprasad Sarbadhikari Gold Medal of the University of Calcutta.

Kapitza wrote three books, namely (1) High Power Microwave Electronics (2) Experiment, Theory and Practice and (3) Le Livre du problem de physique. His collected papers were published in three volumes.

With all these distinctions, Kapitza lived a glorious life for nearly ninety years with vigorous scientific activities for more than sixty years.

In his early life, Kapitza faced serious tragedies by losing his wife and only son. Later on, he married Anna Krylovna, a second time. They had two sons, both scientists in profession. The other tragedies in his life were the hindrance to work in the Cavendish Laboratory after 1935 in spite of a serious agitation in the scientific community of the world and his house confinement during 1946-1964. In this period he lost his affiliation with his Institute for Physical Problems, which he built from nothing and nurtured it from the very beginning as its Director. ☐

S. B. Karmohapatro

NOTES & NEWS

Variable Energy Cyclotron at Calcutta Development in 1984

In July 1984 a new schedule of cyclotron operation was introduced. The cyclotron operated round the clock for two weeks continuously followed by one week of maintenance. This mode of operation significantly improved the efficiency of the machine and hence the beam time available for experiments also increased. Subsequently from October onwards further improvement in the machine operation is made and the cyclotron is now operational for three weeks continuously followed by one week of maintenance. This is a factor of two improvement from the earlier routine of four days running followed by three days of maintenance in a week's time.

The dividend of this exercise turned out to be rewarding—the performance efficiency of the machine has greatly improved with the beam on target for over 70% of the allotted time despite frequent power dips from the external power grid and other non-essential niggling problems. Clearly, quite a few of the hardware problems which plagued the operation in the previous cycle have been ironed out just by virtue of running the machine continuously. The general quality of the beam has also improved greatly. We are now going to adopt this pattern as a routine and hope to go for continuous running with occasional maintenance shut downs.

Efforts are on to improve the beam quality. Requirements on the beam quality vary from one experiment to other. Pulsed nature of the cyclotron beam is ideally suited for studies of nuclear isomeric states. For spectroscopy of nuclear isomeric states having lifetimes in the range 20 to 100 nanoseconds, it is desirable to have projectile beam pulse widths less than 10 nanoseconds. This is also true for studies of fission isomeric states having lifetimes less than 100 nanoseconds. Moreover, for measurements of nuclear lifetimes in the nanoseconds range, the exact shape of the beam pulse time structure is required as an input.

Systematic studies have been carried out to optimize the VEC alpha beam time structure. For this, the gamma ray time spectrum method with fast time resolution (300 picoseconds) is utilized to study the time structure of the alpha beam. Without any internal slit and using a bevelled ion source slit, the beam pulse width was measured to be 15.4 nanoseconds at a pulse separation of 141.2 nanoseconds corresponding to the cyclotron frequency 7.082 MHz and alpha beam energy of about 40.0 MeV. By using an unbevelled slit on the ion source and optimizing the central region parameters, particularly the dee voltage, the pulse width was reduced down to 4.0 nanoseconds. This improvement in the pulse width was brought about by two facts i.e. (a) in the case of unbevelled slit the extracting electrical field between the ion source and the puller electrode did not penetrate well into the plasma column resulting in a smaller accepted RF phase range and (b) increasing the phase bunching effect which is prominent in the first two or three turns. In this region the ions spend considerable fraction of their revolution time under the influence of the electric field. This performance of the VEC compares well with the performances of similar cyclotrons in operation elsewhere and has been reproduced recently with the set of parameters found a few months earlier.

The following are some of the research problems which were pursued in the Variable Energy Cyclotron in 1984 :

(1) Angular distribution of alpha elastic scattering on Au-197 at $E = 36$ MeV was measured and analysed in terms of optical model.

(2) Alpha inelastic scattering from Te-130 was investigated at $E = 40$ MeV to obtain information about the quadrupole deformation parameter and the excitation mechanism.

(3) Single proton transfer reaction induced by alpha particles on Al-27 at $E = 40$ MeV.

(4) Radiation chemistry of liquids or solutions in high LET region to correlate the experimental data with 'spar overlap' model.

(5) Radiation damage and annealing behaviour of defect on 30 MeV α irradiated Molybdenum with $\sim 1.2 \times 10^{17}\ \alpha/\mathrm{cm}^2$; Nickel single crystal with $0.7 \times 10^{17}\ \alpha/\mathrm{cm}^2$.

(6) Effect of α irradiation on the super conducting critical temperature as well as lattice parameter on a $\mathrm{Nb_3Sn}$ layer.

(7) Properties of radiation induced lipid peroxidation. ☐

VECC News Letter

Electric power from rice paddies

One farm on the Ili river in Eastern Kazakhstan is now getting electric power from rice paddies.

The rice paddy, submerged in water, is a huge natural battery. This conclusion has been reached by Academician Vladimir Borovsky, Director, Soil Institute of the Kazakh Academy of Sciences. It heralds a truly revolutionary change in the growing of this crop of paramount importance to man. The roots of rice seedlings are within the negative soil potential. In the meanwhile, the stalks are washed by the positively charged electrolytes—a weak solution of salts in the irrigation water. And wherever there is a potential difference, electric current is inevitable.

The hypothesis was tested in practice. In early spring, before flooding the paddies, part of electrodes were put straight on the soil. Another part of them were buried. And the paddies began generating electric power. ☐

Soviet Features

Juniper tree protects against pathogenic bacteria

Scientists of Kirghizia (Soviet Central Asian Republic) have developed a very simple technology of extracting oil from juniper trees which are abundant in this region.

Since time immemorial, it has been known that a child sleeping in a juniper cradle will grow healthy and strong. The scientists have established that the plant releases phytoncides which protect human organisms against pathogenic bacteria.

The juniper oil, called Archa, quickly heals small cuts, certain skin diseases, burns, bedsores, etc. It can also be used as an anaesthetics against attacks of rheumatism, osteochondrosis and other similar ailments. The food industry will add Archa to its products as an aromatic and medicinal agent.

The oil is extracted from the wastes of timber and wood-working industry. □

Soviet Features

LETTERS TO THE EDITOR

Effect of different treatments and date of harvesting on pectin methyl esterase activity during ripening of Patharnakh pear fruits, *Pyrus pyrifolia* (Burm.) Nakai

The changes in cell-wall composition which accompany the softening of ripening fruit apparently result from the action of enzymes produced by the fruit. Prominent among the enzymes implicated are polygalacturonase and pectin esterase, because striking changes in wall pectin content are observed in ripening fruit. Holl[3] found that softening of the fruit was associated with the rise in activity of many hydrolytic enzymes. He observed an increase in the activity of pectin methyl esterase during ripening of the fruit. Patharnakh is the commercial cultivar of pear in Punjab and the area under this fruit crop is increasing fast. Its fruit is very hardy in nature. Keeping in view, the present investigation was undertaken to see the effect of different treatments and date of harvest on pectin methyl esterase and its relation to the softening of fruit.

The study on the ripening behaviour of Patharnakh pear fruits were conducted in the Department of Horticulture, PAU, Ludhiana during 1980 and 1981. The fruits were obtained from 14-year-old trees growing at RFRS, Bahadurgarh (Patiala).

The fruit samples were collected randomly from the trees at weekly intervals over a 22-day period beginning July 22 during 1980 and July 15 in 1981. Thirty fruits of each harvest date were given the six different treatments (Table 1). Fruits of each harvest date were dipped in ethrel solution for 2 min, air-dried and kept at room temperature and the fruits were tightly wrapped in newspaper enclosing CaC_2 in a vial which was moistened with a drop of water. Temperature of 21-24°C was maintained in the incubator.

For the enzyme extraction, the fruit samples were stored immediately in a freezer at 0°C till their further use. The fruit pulp was subsequently ground in a chilled mortar with the extraction buffer (2 g pulp in 10 ml of phosphate buffer, 6.5 pH). Polyvinyl pyrolidine (PVP) was added along with the extraction buffer to avoid any inactivation of the enzyme by the phenolic constituents of the Patharnakh pear. The extracts were centrifuged at 10,000 rpm for 10 min in a refrigerated centrifuge at 0°C and enzyme activity was studied immediately. The method of Dingle *et al.*[1] was followed for the estimation of PME. The activity of this enzyme was determined by measuring the increase in acidity after the dydrolysis of pectin by the enzyme preparation. The PME activity was calculated as the microequivalents methoxyl groups liberated per hour by one ml of the enzyme preparation under the specified conditions of the reaction. Total soluble proteins were estimated by the method of Lowry *et al.*[4]

The fruit firmness was measured with the help of 'Fruit-Tester' Penetrometro after removing a skin about one square inch (2.5 cm). Ripening the fruits with calcium carbide (2 g/5 kg fruit), ethrel 1000 ppm, temperature (21-24°C) and calcium carbide (1 g/5 kg fruit) increased the PME activity significantly during 1980 (Table 1). Ripening the fruits with calcium carbide (2 g/5 kg fruit) recorded the highest PME activity during 1980 and 1981. The second best treatment with regard to PME activity was ethrel 1000 ppm and calcium carbide at the rate of 1 g/5 kg of fruit during both the years. The lowest PME activity was recorded in case of fruits under control during both the crop seasons. Similar results have been reported by many workers on different fruits[2,6]. An increase in the activity of PME on DNA basis has been reported with the ripening of Japanese pear fruit[7]. A little change in the PME activity of of Bartlett pear was reported[8].

The date of harvest had a significant effect on the PME activity in the pear fruit during both the years of study (Table 2). The lowest PME activity was recorded in case of the fruits harvested on July 15 and July 22 during 1981 and 1980 respectively. There was a progressive increase in the activity of PME with each delay in the date of harvesting from July 22 to August 12 and July 15 to August 5 during both the years. Ripening the fruits for 12 days resulted in an increase in the PME activity during both the fruiting season.

TABLE 1 : Effect of different treatments on the PME activity and firmness in fruits after 12 days of ripening

Treatment	Pectin mathyl esterase (meg/hr/mg protein)			Firmness (kg/inch^2)		
	1980	1981	Average	1980	1981	Average
Ethrel 500 ppm	0.009	0.011	0.0100	7.33	7.13	7.230
Ethrel 1000 ppm	0.012	0.013	0.0125	7.29	6.97	7.130
CaC_2 1 g/5 kg fruit	0.011	0.015	0.0130	7.19	6.97	7.080
CaC_2 2 g /5 kg fruit	0.014	0.018	0.0160	6.94	6.67	6.805
Temperature (21-24°C)	0.011	0.014	0.0125	7.71	7.33	7.520
Control	0.007	0.010	0.0085	7.82	7.50	7.660
C. D. at 5%	0.003	NS		0.48	0.40	

TABLE 2 : Effect of date of harvest on the PME activity and firmness in fruits after 12 days of ripening

Date of harvest (1980)	PME (meg/hr/mg protein) (days after ripening)		Firmness (kg/inch^2) (days after ripening)		Date of harvest (1981)	PME (meg/hr/mg protein) (days after ripening)		Firmness (kg/inch^2) (days after ripening)	
	0	12	0	12		0	12	0	12
July 22	0.002	0.007	8.85	7.74	July 15	0.001	0.007	9.00	7.59
July 29	0.004	0.010	8.70	7.53	July 22	0.005	0.012	8.87	7.35
Aug. 5	0.007	0.014	8.50	7.24	July 29	0.008	0.016	8.67	6.81
Aug. 12	0.008	0.013	8.27	7.01	Aug. 5	0.009	0·020	8.40	6.63
C. D. at 5%		0.002		0.39			0.005		0.33

It is interesting to note that with an increase in the PME activity, there was corresponding decrease in the fruit firmness in the fruit treated with ethrel and calcium carbide. Hultin and Levine[8] have also reported similar results in banana. Holl[2] found that softening of the fruits was associated with the rise in activity of many hydrolytic enzymes.

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Improving sex ratio in sweet lime by planofix and ethrel

The sweet-lime fruit (*Citrus limettioides* Tanaka) commands the market during August-September due to its early ripening and therapeutic value as compared to all other citrus species commercially raised in Punjab. The cultivation of sweet-lime, however, is limited because of its shy-bearing habit which is due to considerable high proportion of staminate flowers[1-3]. Scanty information is available on the effect of growth regulators on sex ratio in this species[4,5]. Therefore, a study was conducted to assess the role of different growth regulators-planofix (a commercially available form of naphthaleneacetic acid) and ethrel [(2-chloroethyl) phosphonic acid] in modifying sex expression in this species for better fruit set.

Seven-year old trees being grown at the Fruit Research Station, Bathinda were selected for experimentation. The trees were sprayed with 250, 500 and 1000 ppm solutions of planofix [a product of May & Baker (India) Ltd.] and ethrel (a product of Agromore Ltd., Bangalore) on February 21, 1984. Experiment was replicated thrice, keeping one tree as a treatment unit. The trees sprayed with water served as controls. Male and the hermaphrodite flowers were counted from all sides of the tree. On each tree, five hundred flowers were observed for their sex. The angular transformation of data was done.

Both growth regulators increased the percentage of hermaphrodite flowers and the increase was a direct function of the concentration of the chemical applied (Table 1).

TABLE 1 : Effect of planofix and ethrel on percent hermaphrodite flowers

Treatment (ppm)		Hermaphrodite flowers (%)
Planofix		
	250	19.36(10.99)
	500	27.00(20.61)
	1,000	34.11(31.45)
Ethrel		
	250	18.63(10.21)
	500	24.69(17.45)
	1,000	32.05(28.16)
Control		18.24(9.80)
C. D. at 5%		3.73
C. D. at 1%		5.23

Figures in parentheses are retransformed values.

However, the maximum amount of hermaphrodite flowers was obtained by 1,000 ppm planofix.

This clearly indicates that trees of sweet-lime should be sprayed with higher concentrations of planofix or ethrel for improving sex-ratio and subsequent fruit set.

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Reproductive potential of *Cotesia diurnii* Chalikwar and Nikam (Hymenoptera : Braconidae), a larval parasitoid of *Exelastis atomosa* Fab. in relation to host density

The ratio of increase of parasitoids from generation to generation with host densities largely depend on their searching activity and responses to variable host densities. The present host parasitoid model suggests parasitoid-searching ability and reproductive potentiality which are optimum for their selection in biocontrol. However, few attempts[1-5] have been made on the aspects of host/parasitoid interaction.

Early second instar larvae of *E. atomosa* were exposed in densities of 10, 20, 30, 40 and 50 to a mated female parasitoid for 24 hr fed on fresh pigeonpea pods and 20% honey. Parasitized hosts were separated in plastic containers for futher observations made at laboratory conditions (24±1°C, 55 - 60% R.H.).

The number of parasitoids obtained from host density 40 was highest, 50 with 20% parasitism as compared to other host densities, 10, 20, 30 and 50 recorded 16.12, 17.85, 19.44 and 16.33 percent parasitism (Table 1).

TABLE 1 : Reproductive potential of *C. diurnii* in relation to host density

Host density	No. of replicates	Total number of individuals obtained			% of Emergence of moths and parasitoids	Mean % of parasitism
		Moths	Parasitoids	Both		
10	8	52	10	62	77.50	16.12
20	8	92	20	112	70.00	17.85
30	8	145	35	180	75.00	19.44
40	8	200	50	250	78.12	20.00
50	8	251	49	300	75.00	16.33

Mean percent parasitism based on total number of parasitoids and moths

In *orgilus lepidus* Muesebeck, parasitoid of *Pthorimaea operculella* Zeller parasitoid progeny increased with increase in the number of hosts and maximum progeny was produced from 150 larvae[3]. Ninety host larvae of *Kaiferia lycopersicella* (Walsingham) was optimum number for maximum parasitism by *Apanteles dignus* Muesebeck.[1] Odebiyi and Oatman[4] reported that in *Agathis gibbosa* Shenefelt 100 larvae of potato-tuber moth was the most effective number for maximum progeny production while potato tubers with 50, 75, 125 and 150 larvae produced less parasitoids. In the present form, 40 host density produced maximum progeny production (50) and parasitism (20%) with definite host parasitoid relationship. On the other hand, Yeargan and Latheef[5] recorded no density dependent relationship between host and parasitoid in *Hypera postica* (Gullen.) and *Bathyplectes curculionis* (Thom.). In *Compoletis chlorideae* Uchida, parasitoid of *Heliothis armigera* (Hubn.) 40 host larvae has optimum host density which produced 40.68% progeny[2]. These findings are in agreement with definite host-parasitoid relationship for reproductive potetial.

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Effect of water stress on some aspects of nitrogen metabolism in *Vigna* seedlings

Adaptive responses of a plant against any environmental stress must be reflected in its metabolism through gene expression[1]. Rapid alteration in nitrogen metabolism during water stress is an advantage to plants. In the present study, some specific stress-responses in terms of protein, amino acids, proline and total nitrogen content and activities of some enzymes related to it were followed to elucidate the role of nitrogen metabolism in stress-tolerance of seedlings.

TABLE 1 : Relative water content (RWC), leaf water potential (LWP), protein content (mg (100 mg dry wt)$^{-}$), protease activity, glutamate pyruvate transaminase (GPT) activity, glutamate oxaloacetate transaminase (GOT) activity, free amino acid (mg (100 mg dry wt)$^{-1}$), proline (μ mole (100 mg dry wt)$^{-}$) and total nitrogen (mg (100 mg dry wt)$^{-1}$) content of *Vigna* seedlings (17-days-old) subjected to different magnitudes of water stress for 2 days. Enzyme activities were expressed as enzyme unit (100 mg dry wt)$^{-1}$ min^{-1}

Magnitude of water stress (MPa)	RWC (%)	LWP (MPa)	Protein content	Protease activity	GPT activity	GOT activity	Free amino acid content	Proline content	Total nitrogen content
Non-stress (control)	98.9	−0.52	61.5	0.024	0.038	0.019	0.86	8.7	6.04
−0.5	93.4	−1.0	36.0	0.030	0.020	0.0090	0.88	10.5	7.15
−1.0	90.0	−1.55	00.2	0.038	0.013	0.0080	1.13	16.4	8.31
−1.5	86.0	−2.20	24.5	0.044	0.010	0.0080	1.23	19.6	9.0
C.D. at P =0.05	0.91	0.24	4.02	0.005	0.09	0.004	0.08	0.83	0.54

Vigna seedlings were prepared and water stress was maintained by the method of Mukherjee and Choudhuri[2]. In one experiment, seeds were pretreated with CaCl$_2$ solution according to the method described earlier[3] and 15-day-old seedlings were raised thereafter. Now, 2 lots of Ca-pretreated seedlings were subjected to water stress for 2 days by immersing the root systems of plants in PEG-6000 solution at −1.0 MPa only. All the plants were maintained in a growth-room (12 h light and μE m^{-2} sec^{-1} and 24±2°C).

After the water stress, the sampling was done by following Mukherjee and Choudhuri[2] and then following studies were made. The relative water content (RWC) and leaf-water potential (LWP) were estimated following the method given by Mukherjee and Choudhuri[2]. Protein was extracted from the residue of a methanolic extract of chlorophyll by digestion with 2 ml of 1 M NaOH for 20 min at 80°C and estimated by the method of Lowry *et al*[4]. Total free amino acid content was determined by ninhydrin method[5] from the ethanolic extract of the leaf tissue. Proline was estimated following the method of Bates *et al*[6]. Protease activity was assayed following the method described by Mukherjee and Choudhuri[7]. For the estimation of glutamate pyruvate transaminase (GPT) and glutamate oxaloacetate transaminase (GOT) 500 mg leaf samples were homogenised with cold 0.1 M phosphate buffer (pH 7.4). The homogenate was centrifuged at 5000 g for 5 min. The filtrates were used as enzyme sources. Both the enzymes were assayed following the method of Reitman and Frankel[8]. Total nitrogen was estimated from dried leaf tissue by digesting it with conc H$_2$SO$_4$. After complete digestion, a few drops of fresh H$_2$O$_2$ was added and the volume was made up to 200 ml with distilled water. Now total nitrogen content was estimated with Nessler's reagent[9]. The experiments were replicated 6 times from two independent sources and were statistically analyzed[8].

Seedlings subjected to a stress of − 1.0 MPa suffered reproducible stress effects (Table 1). Water deficit resulted in a decline of protein content. This decline might be caused by the impairment of protein synthesizing machinery[10-12] or might be a consequence of hydrolysis of protein. The decrease in GPT and GOT activities during water stress supported the earlier observations of Gupta and Sheoran[13] who demonstrated that water stress reduced the rate of protein synthesis in *Brassica* sp. by reducing GPT and GOT activities. That considerable protein hydrolysis occurred in the present case could be substantiated by higher protease activity and by accumulation of free amino acids in stressed seedlings. There was a substantial accummulation of amino acids including proline in water-stressed seedlings which is reminiscent of the observations of other workers in different plants[14, 15]. It seems likely that higher proteolysis concomitant with lower protein synthesis might be one of the major causes of proline accumulation in water-stressed *Vigna* seedlings. Higher total nitrogen content in leaves of seedlings than in nonstressed plants (Table 1) might result from either non-mobilization of nitrogenous components from leaves to other parts of the plant[16].

Several reports have indicated that Ca is an important hardening agent against water stress in field-grown crop plants[17, 18]. Here also, Ca treatment improved water status of *Vigna* seedlings significantly (Table 2). Ca-mediated improvement in protein content might be due to decreased protease activity and increased GPT and GOT activities and such improvement was also accompanied by a decrease in free amino acids including proline. Sashidhar *et al.*[19] observed in groundnut that treatment of Ca increased proline level and suggested that Ca-induced increase in proline is presumably involved in osmotic adjustment of tissues making the plant tolerant against drought. To the contrary, the present study showed a decline of proline in Ca-treated seedlings with significant improvement in water status. It appears that improved water status creates a condition which is not conducive to proline accumulation. Such observation also finds support from that of Nayek *et al.*[17] in field-grown rice plant. Ca-treatment also prevented accumulation of nitrogen in stressed-leaf

TABLE 2 : **Effects of pretreatment of seeds with $CaCl_2$ (10^{-2} and 10^{-4} M) on relative water content (RWC), leaf water potential (LWP), protein content (mg (100 mg dry wt)$^{-1}$), protease activity, glutamate pyruvate transminase (GPT), glutamate oxaloacetate transaminase (GOT) activity, free amino acid (mg (100 mg dry wt)$^{-1}$), proline (μ mole (100 mg dry wt)$^{-1}$) and total nitrogen content (mg (100 mg dry wt)$^{-1}$) of *Vigna* seedling (17 days old) subjected to −1.0 MPa water stress for 2 days. Enzyme activities were expressed as enzyme unit (100 mg dry wt)$^{-1}$ min^{-1}**

Treatments	RWC (%)	LWP (MPa)	Protein content	Protease activity	GPT activity	GOT activity	Free amino acid content	Proline content	Total nitrogen content
Non-stress (control)	98.9	−0.52	61.5	0.024	0.0380	0.019	0.86	8.8	6.04
10^{-2}M $CaCl_2$ + Control	99.2	−0.48	65.4	0.012	0.0395	0.020	0.72	6.4	5.90
10^{-4}M $CaCl_2$ + control	98.9	−0.51	62.3	0.019	0.0383	0.019	0.84	7.3	5.95
Stress (−1.0 MPa)	90.0	−1.55	30.2	0.038	0.013	0.0086	1.13	16.4	8.31
10^{-2}M $CaCl_2$ + Stress	92.4	−1.34	37.1	0.028	0.027	0.0135	0.97	12.4	7.01
10^{-4}M $CaCl_2$ + Stress	91.0	−1.45	33.1	0.032	0.018	0.0094	1.09	14.1	8.02
C.D. at P=0.05	1.01	−0.20	3.10	0.006	0.010	0.003	0.09	0.91	0.97

tissue (Table 2), indicating a lower breakdown of nitrogenous compounds. Active mobilization of nitrogen to other sites from leaves might also be one of the reasons of depleted nitrogen in Ca-treated stressed leaves of *Vigna* seedlings. This can also be justified by the fact that Ca is known to play an important role in the transport system by maintaining the membrane in a functional state[20].

Thus, it can be suggested that both protein synthesis and breakdown were effected by water stress and an improvement of water status causes an improvement in protein status of stressed seedlings. It also seems that increased proline level with adverse water status and decreased proline level with favourable water status might not be related to osmotic adjustment of stressed *Vigna* seedlings and consequently with drought tolerance.

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New records and host range of predators of aphids (Aphididae : Homoptera) in Kashmir Valley, India

A detailed survey of natural enemies of aphids of Kashmir Valley from 1975-1982 has revealed seventeen species of insect predators belonging to different orders *viz.*, Coleoptera, Diptera and Heteroptera, attacking twenty five species of aphids. The predatory species are recorded for the first time from this region. The various aphid predators were collected by laboratory rearing of aphid colonies brought from various localities and ecological habitats of Kashmir Valley.

Previous work with respect to the aphid predators of Jammu & Kashmir State has been done by : Hull[1], Zaka-ur-Rab[2], Kapur[3]; Lambeck and Brink[4] and Ahmad & Vaishnavi[5]. In this communication, the newly recorded species of aphid predators, with host range and other collection data are listed below. The material dealt with here are deposited in the Museum of P. G. Department of Zoology, Kashmir University.

COLEOPTERA

I. Bruchidae

Bruchidius sp.

Host : *Amphicercidus tuberculatus* David, Narayanan and Rajasingh from *Lonicera quinquelocularis*, 9.vi.1977, Zeetyar, Srinagar.

II. Cassidinae

Aspidomorpha indica Boheman

Host: *Acyrthosiphon rubi* Narzikolov from *Rubus fruticosus*, 6.vii.1980, Kokernag.

III. Coccinellidae

1. *Adalia tetraspilota* (Hope)

Host: *Aphis craccivora* Koch from *Robinia pseudoacacia*, 12.vi.1980, Srinagar and from *Medicago sativa*, 26.v.1979, Srinagar; *Aphis gossypii* Glover from *Zennia elegans*, 11.vi.1980, Cheshmashahi, Srinagar; *Aphis* sp. from unidentified plant, 6.vii.1982; *Myzaphis rosarum* (Kaltenbach) from *Rosa webbianna*, 5.v.1977, Srinagar.

2. *Aiolocaria hexaspilota* (Hope)

Host: *Tetraneura* sp. from *Ailantus altissma*, 17.vi.1977, Ducksum.

3. *Coccinella undecimpunctata* Linnaeus

Host: *Aphis pomi* De Geer from *Pyrus malus*, 26.vi.1980; Srinagar.

4. *Coccinella* sp.

Host: *Aphis craccivora* Koch from *Medicago polymorpha*, 8.vi.1978, Srinagar.

5. *Platynaspis saudersii* Crotch

Host: *Aphis kurosawai* Takahashi from *Daphne oleoides*, 25.x.1973, Shankracharya Hill, Srinagar.

6. *Synharmonia conglabata* (Linnaeus)

Host: *Aphis fabae* Scopoli from unidentified plant, 5.vi.1979, Srinagar.

DIPTERA

I. Chamaemyiidae

1. *Leucopis* (*Leucopis*) sp.

Host: *Aphis* sp. from *Pyrus malus*, 14.vi.1978, Hazratbal, Srinagar; *Hyalopterus pruni* (Geoffroy) from *Phragmites communis*, 9.viii.1975, Ashaibagh, Srinagar.

2. *Leucopis* sp.

Host: *Macrosiphoniella sanborni* (Gillet) from *Chrysanthemum morifolium*, 12.v.1977, Cheshmashai, Srinagar; *Prociphilus* sp. from *Lonicera* sp., 4.vi.1978, Tangmarg near Gulmarg.

II. Drosophilidae

Scaptomyza (*Parascaptomyza*) *pallida* (Zetterstedt)

Host: *Aphis fabae solonella* (Theobald) from *Rumex nepalensis*, 26.vi.1978, Gulmarg.

III. Syrphidae

1. *Episyrphus balteatus* (De Geer)

Host: *Aphis craccivora* Koch from *Robinia pseudoacacia*, 10.v.1976, Srinagar; *Indochaetophorus furcatus* Verma from *Ulmus wallichiana*, 27.vi.1978, Srinagar; *Schizoneurella indica* Hille Ris Lambers from *Ulmus* sp.

2. *Sphaerophoria indiana* Bigot

Host: *Hyalopterus pruni* (Geoffory) from *Prunus domestica*, 1. v. 1976, Hariparvat, Srinagar.

3. *Syrphus* sp.

Host: *Chaetosiphon chaetosiphon* (Nevsky) from *Rosa* sp., Zabervan, 11.v.1975; *Lipaphis erysimi* (Kaltenbach) from *Brassica campestris*, 4.v.1976; Malbagh, Srinagar; *Eriosoma lanigerum* (Hausman) from *Pyrus malus*, 9.vi.1975.

HETEROPTERA

I. Anthocoridae

1. *Anthocoris* sp.

Host: *Pemphigus immunis* Buckton from *Populus ciliata*, 12.vi.1976, Srinagar.

2. *Orius* (*Orius*) *lindbergi* Wagner

Host: *Anuaphis persicae* (Smith) from *Prunus amygdalous*, 30.iv.1975; Srinagar; *Aphis craccivora* Koch from *Medicago sativa*, 27.v.1982, Hazratbal, Srinagar; *Macrosiphoniella artemisae* (Boyer de Fonoscolombe) from *Artemisia* sp., 27.vi.1980, Shankracharya Hill, Srinagar; *Pemphigus mordvilkoi* Cholodkovsky from *Populus caspica*, 12.viii.1977, Srinagar.

3. *Orius* (*Heterorius*) *minutus* (Linnaeus)

Host: *Amphicercidus tuberculatus* David, Narayanan and Rajasingh from *Lonicera quinquelocularis*, 7.iv.1977, Srinagar; *Brachycaudus cardui* Linnaeus from *Carduus edelbergi*, 6.vi.1975, Hazratbal, Srinagar.

The authors are highly grateful to Dr. D. N. Fotedar, Head, P. G. Department of Zoology for providing all the necessary laboratory facilities. Many thanks are due to the Director, Commonwealth Institute of

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Oocyte classification in *Bufo melanostictus*

A number of schemes have been proposed for the classification of oocytes of adult anuran amphibians[1-6]. Two schemes are available for *Bufo melanostictus*[7,8]. Since both the schemes are deficient in certain respects, an attempt has been made here to devise a classificatory scheme based on clearly discernible external and internal characters.

Female toads were collected from different localities in and around Calcutta. Following Inger and Greenberg[9], presence of oviducal convolution was regarded as criterion of maturity.

For the study of internal structure, oocytes were fixed in Smith's Fixative, dehydrated through ethyl alcohol, cleared in methyl salicylate or chloroform and embedded in low temperature paraffin. Six μm thick sections were stained in Delafield's Haematoxylin—Eosin and in Heidenhain's Azan, as modified by Czolowska[10].

In the adult toad, the ovary undergoes periodic progressive changes whereby its contained oocytes pass through a cycle of growth and differentiation for the ultimate goal of ovulation and fertilization. Each oocyte is enveloped by follicle made up of an outer ovarian-sac epithelium, a middle vascular theca and an inner follicular epithelium.

The normal development of the oocyte has been divided into seven stages (as described in Table 1) based on egg diameter, pigmentation, nuclear morphology and yolk distribution. This staging, is, in a sense, arbitrary since the growth and development of the oocytes is a continuous process. It is also to be noted that the adult ovary contains, in addition to a particular category (stage) of oocytes, one or more category of eggs, though in far lesser number.

Besides the points mentioned in Table 1, it is observed that the animal and vegetal poles are just distinguishable and the vitelline membrane is distinct in stage IV. Further, the most distinguishing feature of the oocyte of the stage VI is the presence of an equatorial unpigmented annular band (about 0.2 mm thick) separating the animal and vegetal hemispheres.

In most of the earlier schemes of oocyte classification, these easily discernible internal characters were not considered. The most notable and comprehensive classification was proposed by Dumont[6]. He grouped the oocytes into six stages taking into account precise egg diameter ranges, external pigmentation, nuclear morphology, yolk distribution, etc. Church[7] and Basu[8] divided the oocytes of *B. melanostictus* into six categories based on size and pigmentation, and five groups on the same basis and some internal characters respectively but did not indicate the size ranges. The former used the terms "small" and "large" and the latter 'small", "medium" and "large"

The classificatory scheme adopted here differs from those of earlier workers[6-8], in several respects. The most early oocytes are transparent and undifferentiated cells. These are resting stage cells in which yolk synthesis is yet to begin. These resemble the oocytes of immature animals and hence are included in STAGE 0.

Dumont's[6] Stage III is too large and includes oocytes showing a variety of pigmentation pattern beginning from "light brown to uni-

TABLE 1 : **Description of different oocyte stages**

Stage	0 (Previtellogenetic)	I (Vitellogenetic)	II (Vitellogenetic)	III (Vitellogenetic)	IV (Vitellogenetic)	V (Vitellogenetic)	VI (Post-vitellogenetic and pre-ovulatory)
Diameter (μm)	80-300	300-400	400-800	800-1000	1000-1250	1250-1400	1400-1600
Colour & pigmentation	Transparent; no pigmentation	Opaque ; pigmentation not externally visible	Opaque, but pigmentation visible; yellow, tan or brown	Rich dark brown pigmentation uniformly distributed	Animal pole dark brown to black, vegital pole slightly paler brown	Animal pole dark brown, vegital pole paler brown	As in V
Nucleus	Central ; large	Central : large	Central ; still large compared to the size of the cell	Slightly eccentril, large, but the increase in the ooplasmic size far outstripped the increase of nuclear size	Definitely eccentric, displaced towards the animal pole	Eccentric nucleus displaced towards the animal pole	Eccentric, situated near the top of the animal pole
Nuclear membrane	Outline smooth	Slightly wavy	Lightly folded	Deeply folded	Less deeply folded than in III	Short folds, more prominent towards the vegital pole	Slightly folded mostly on the vegital pole side
Nucleoli	None to few, scattered at random	More in number ; some lying close to the nuclear membrane	Many; located very close to the nuclear membrane, even within the folds of the nuclear membrane ; large	Many; mostly large and peripheral	Many deeper in the nucleoplasm, a few larger ones peripheral	Less in number ; mostly peripheral	Fewer, more towards the centre
Yolk	Absent	Little, in the form of small spheres at the periphery	Much increased	Much increased ; some yolk platelets small and round, other large and elongated	Further increased ; small round and compact yolk platelets towards animal pole, but larger elongated and loosely arranged towards vegital pole	Further increased ; polar distribution	Yolk platelets large ; distinct polar distribution
Cytoplasm	Homogenous filling whole cell, no cortical granules and melanosomes	With a single layer of cortical granules ; no melanosomes	Generally displaced towards the nucleus forming a broad perinuclear ring ; some scattered in irregular, isolated patches within yolk	Mainly in the form of perinuclear ring ; melanosome in the form of a continuous peripheral band	Forming definite perinuclear ring, wider towards vegital pole; few cytoplasmic islands within the yolk ; melanosome distribution in periphery almost uniform in animal and vegital poles	Cytoplasmic island displaced towards animal pole	Few cytoplasmic islands just below the perinuclear cytoplasmic ring in the animal pole

formly blackish brown". Agreeing with Church[7] and Basu[8], oocytes corresponding to Dumont's[6] Stage III have been included into two different catagories—STAGE II containing oocytes of variable pigmentation but other than uniform dark brown, and STAGE III containing oocytes of uniform dark brown colour. A late post-vitellogenetic stage has been reported in *Rana temporaria*[3] and *Xenopus laevis*[6]. Such a stage has also been found to occur in *B. melanostictus* and described in the study as Stage VI.

TABLE 2 : Comparative chart showing major schemes of oocyte classification. Three schemes, not mentioned in the discussion are also included for comprehensiveness

<table>
<tr><th></th><th colspan="12">Stages</th><th>Reference</th></tr>
<tr><td rowspan="3">B
U
F
O</td><td>0</td><td colspan="2">I</td><td colspan="2">II</td><td colspan="3">III</td><td colspan="2">IV</td><td>V</td><td>VI</td><td>Ray & Mitra</td></tr>
<tr><td colspan="3">I</td><td colspan="2">II</td><td colspan="3">III</td><td colspan="2">IV</td><td colspan="2">V</td><td>Basu, 1962</td></tr>
<tr><td>VI</td><td colspan="2">I</td><td colspan="2">II</td><td colspan="3">III</td><td colspan="2">IV</td><td colspan="2">V</td><td>Church, 1960</td></tr>
<tr><td rowspan="3">R
A
N
A</td><td colspan="3">Ia & Ib</td><td colspan="5">II & III</td><td colspan="4">IV</td><td>Rosenbaum, 1958</td></tr>
<tr><td>A</td><td colspan="2">B</td><td colspan="5">C</td><td colspan="3">D</td><td>E</td><td>Grant, 1953</td></tr>
<tr><td colspan="2">Y_0</td><td colspan="2">Y_1</td><td colspan="2">Y_2</td><td>Y_3</td><td colspan="3">Y_4</td><td colspan="2">Y_5</td><td>Kemp, 1953</td></tr>
<tr><td rowspan="3">X
E
N
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P
U
S</td><td>I</td><td colspan="2">II</td><td colspan="5">III</td><td colspan="2">IV</td><td>V</td><td>VI</td><td>Dumont, 1972</td></tr>
<tr><td>1 & 2</td><td colspan="2">3</td><td colspan="5">4</td><td colspan="2">5</td><td colspan="2">6</td><td>Davidson, 1968</td></tr>
<tr><td>A & B</td><td colspan="2">C</td><td colspan="6">D</td><td colspan="3">E</td><td>Balinsky & Devis, 1963</td></tr>
</table>

A comparative chart showing major schemes of oocyte classification proposed by different workers and the scheme adopted here is given in Table 2.

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On the performance of some varieties of Isabgol, *Plantago ovata* L. against aphid

Isabgol (*Plantago ovata* L.) is a winter herb which has many medicinal and industrial uses. Its cultivation has been recommended in the South-Western districts of Punjab. The aphid, *Rhopalosiphum maidis*, a serious pest of wheat and barley also infests this crop. So studies were carried out to find out varieties resistant to this pest.

The studies were carried out at the research farm of the Punjab Agricultural University during 1981-82. Fifteen varieties of Isabgol were sown in the second fortnight of October in a randomized block design. The plot size was 5 rows × 3 m and there were four replications. The population of the aphids was recorded in the first and third week of March, 1982 from five spikes of a plant and on five plants from each replication selected at random, on the basis of their mean.

Table 1 reveals that Progeny-3 and EC-42706-2-2 had significantly low aphid population as compared to other varieties. However, these two varieties were statistically at par with P-79, PIS-1, PIS-2 and S-12. The remaining entries were inferior to these with regard to the damage by aphid. Highest population of aphid was recorded on S-11. Therefore, there is a scope for breeding tolerant varieties of isabgol by making use of progeny-3 and EC-42706-2-2 cultivars.

TABLE 1 : Comparative performance of varieties of Isabgol against aphid, *Rhopalosiphum maidis* during 1981-82

Cultivars	Mean* Number of aphids/ spike on		Mean	Ranks
	4.3.82	18.3.82		
EC-42706-1-2	71.0^{cde}	32.6^{de}	51.8	10
EC-42706-2-2	53.4^{ab}	19.3^{abc}	36.4	2
G-1-1	72.3^{cde}	30.5^{cde}	51.4	9
P-33	73.9^{cdef}	26.9^{bcd}	50.4	8
P-79	71.2^{cde}	16.4^{ab}	43.8	4
PIS-1	76.3^{cdefg}	22.3^{abcd}	49.3	7
PIS-2	68.8^{cd}	20.5^{abc}	44.7	5
P-11	90.4^{h}	38.8^{e}	64.6	12
Progeny-3	50.9^{a}	14.7^{a}	32.4	1
Progeny-10	82.3^{efgh}	40.4^{h}	61.4	11
Progeny-27	88.6^{gh}	40.8^{ef}	64.7	13
S-8	80.1^{defgh}	52.5^{fg}	66.3	14
S-11	85.6^{fgh}	53.2^{g}	69.4	15
S-12	63.8^{bc}	18.6^{ab}	41.2	3
Local	74.7^{cdef}	20.7^{abc}	47.7	6
C.D. $(p=0.05)$	12.7	11.8		

*Mean of 20 spikes

Entries with same letter(s) do not differ significantly as revealed by C.D. value at 5 per cent level of significance.

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Sawed elephant bone unearthed from Barasat, 24-Parganas, W. B. : Reminiscence of ancient ivory carving in Bengal

Sometime in 1981, bones of some animals were unearthed from a depth of about 6.02 m from the surface during renovation of a pond in Gazitola, Debalaya, 24-Parganas. Among others, a large fragment of a limb bone caught the attention of the people of the locality and so subsequently it was sent to me for identification by the Director of the collection of antiquities from Chandraketugarh. Some archaeic objects like Sunga coins, potteries and figurines were also found in close association with the bones in the site of excavation. Therefore, the bone appears to be nearly 2000 years old.

The sawed-bone piece was the distal end of left femur of a very big elephant. It is reminiscent of the fact that ivory or bone carving was a traditionally old industry in Bengal or Gour-Bango. Craftsman generally discards such condylar bones for their irregular shape and rough texture.

From the dimension of the bone, it appears that the elephant concern was very big and probably it was a male specimen. It is comparable with the large mounted skeleton in the Indian Museum which has a record height of 3.86 m, at the shoulder. The girth of the shaft measured at condyle is 70 cm (*cf.* 65 cm in Ind. Mus. specimen) and the condylar width is

25 cm. (*cf.* 26 cm. in Ind. Mus. Specimen). The specimen is now in the possession of Sri Dilip Maite, Director ofthe said collection.

India as a whole, is the pioneer country in bone, horn, ivory and conch work. The Neolithic bone tools are reported from almost every where from Burzahom (Kashmir) to Arikemedu (Tamilnadu). It throws light on the skill of those primitive hunters in making pointed, barbed, hooked, serrated and perforated tools, according to various requirements. The Post-Neolithic people in latter phase started to prepare more sophisticated articles in the country like earings, bangles, necklace, combs, shieves, knives, blades and needles besides those traditional weaponds and instruments.

There after since 2500 B.C. (Harappan onward) till up to 1700 A.D. (Sultani and Nawabi time), the Kings and Monarchs in the country patronised the bone and ivory crafting and as a result the industry got tremendous impetus.

The ivory caskets, chairs, footstool etc., found from Begram, Eastern Afghanistan, remind us of the skill of ancient carvers of Mathura (1st century AD). From 8th to 14th century, different artistic objects made of ivory, were exported to outer countries, including, Nepal, Tibet, Burma, Ceylon and Afghanistan. The famous ivory centers were situated in Delhi, Mysore, Trivancore, Bengal and Orissa.

Earlier, we got similarly sawed or chopped bones of elephants from Tamluk (Midnapur) and Farakka (Murshidabad). It testifies that from time immemorial the people of Bengal were adept in ivory work. Consequently, ivory industries were established in different parts of the state to produce fine and artistic objects like dolls, toys, fans, combs, ornaments, dice, statuettes and many others, which occasionally fetched foreign currencies. The ivory work gained such fame that foreign traders who sailed from Saptogaon, Tamrolipta and Chittagaon never forgot to collect some of the ivory work as memento along with the famous Mosline clothes at the time of their departure.

It is worth mentioning that elephant is the only animal which possesses solid limb bones without marrow cavities. The inner spongy bone is encircled by the outer compact bone tissu, which serves as second-rate ivory in the work. Practically the entire skeliton of an elephant is utilised by the ivory workers. By the by we may recollect the old proverb 'a dead elephant worths a million marks'.

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Effect of nitrogen nutrition and *Rhizobium* on the physiology of mung bean infected with common bean mosaic virus

Nitrogen nutrition has long been recognised as an important factor in modifying host growth and its physiology. If the levels of nitrogen provided are lesser, a reduction in growth is obtained as a result of reduced auxin activity[1], while at the higher levels the plant showed a lusk and rank growth[2]. Miller[3] stated that carbon : nitrogen ratio (C : N) influences the vegetative growth of the plant. Though considerable literature exists on the effect of nitrogen nutrition in relation to host growth and virus multiplication[4], deviation in C : N ratio in plants has not been investigated. Therefore, the present study was made to find out the effect of nitrogen nutrition and *Rhizobium* on the C : N ratio in common bean mosaic virus (CBMV) infected mung bean plants, with a view to establish relationship, if any, between nitrogen nutrition and *Rhizobium* on it in infected plants.

Mung bean cv. Pusa Baisakhi was used as a host plant and CBMV[5] was used for systemic multiplication. Eight different levels (0, 56, 112, 168, 224, 448, 672 and 784 ppm) of nitrogen were prepared from Bollard's solution[6]. The seedlings were raised in paraffin-coated clay pots (12 cm) having sterilized sand. The seedlings of uniform growth (10-day old) were taken in two groups, each comprising 160 pots. The first group

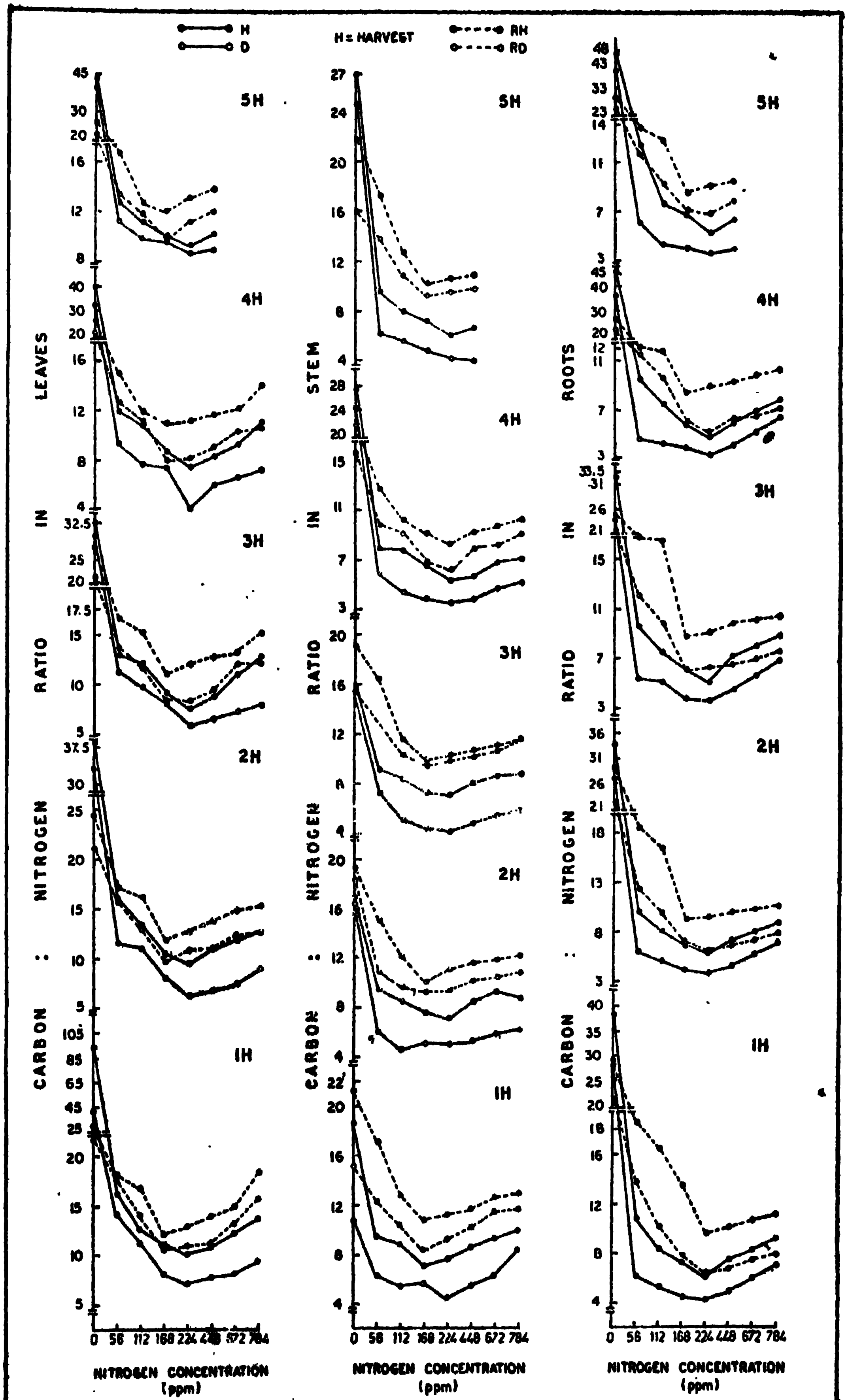

FIG. 1.

FIG. 2.

FIG. 3.

was raised from *Rhizobium* untreated (RUT) and second one from *Rhizobium* treated (RT) mung bean seeds. The *Rhizobium* inoculation of the seeds was done by placing the water-suspension of the bacteria on it. One half of the plants (400 plants) of each group were inoculated with neutral phosphate buffer only to serve as healthy control. The aforesaid four groups of the plants were designated as *Rhizobium* untreated healthy (H), *Rhizobium* untreated diseased (D), *Rhizobium*-treated healthy (RH) and *Rhizobium*-treated diseased (RD).

Ten pots, containing 50 plants were taken for each nitrogen treatment, and seedlings were inoculated by rubbing the virus inoculum over the leaf surface. The harvests were made on 10th, 20th, 30th, 40th and 50th day of inoculation. The C : N ratio in plant samples was derived by dividing the carbon content by nitrogen content of the sample.

Figures 1-3 show that virus infection lowered the C : N ratio in mung bean plants. The reduction in the C : N ratio was, however, less in RT plants than in RUT ones. The C : N ratio in RUT (H and D) and RT (RH and RD) group of plants decreased from 0 to 224 ppm and from 0 to 168 ppm of nitrogen respectively, then increased gradually to 784 ppm of nitrogen in both the groups of plants. For treatments, viz. nitrozen nutrition, virus infection and *Rhizobium* inoculation, F-value were computed for each sampling. Values of variance ratio for nitrogen nutrition and virus infection were significant at 1% level, while *Rhizobium* treatment was significant at 5% level.

In the present study, the virus infection lowered the C : N ratio. Similar findings have also been reported in several host-virus combinations[7-8]. This may be due to low organic carbon and higher nitrogen contents in the diseased plants[9]. The findings of the growth studies showed that decrease in organic carbon at different nitrogen levels (168 and 224 ppm in RT and RUT plants respectively) may be attributed to the vigorous growth of the plant at these levels, which led ultimately to the maximum depletion of organic carbon[9]. However, as soon as the nitrogen level is enhanced, the metabolic activities are suppressed on account of toxicity of nitrogen, resulting in a greater accumulation of organic compounds and thereby the organic carbon. Thus, a very high C : N ratio at 0 ppm indicates the weak vegetative growth of the plant. In this case, nitrogen appears to be a limiting factor for growth and the high ratio is apparently due to the presence of little amount of nitrogen and higher amount of organic carbon. Kraus and Kraybill[10] also gave the similar reasons for higher C : N ratio in plants.

The growth of the RT and RUT plants was maximum at 168 and 224 ppm of nitrogen respectively[9], but the C : N was low. This indicates a balance between the organic carbon and nitrogen supplied to the plants, which produced the best vegetative growth.

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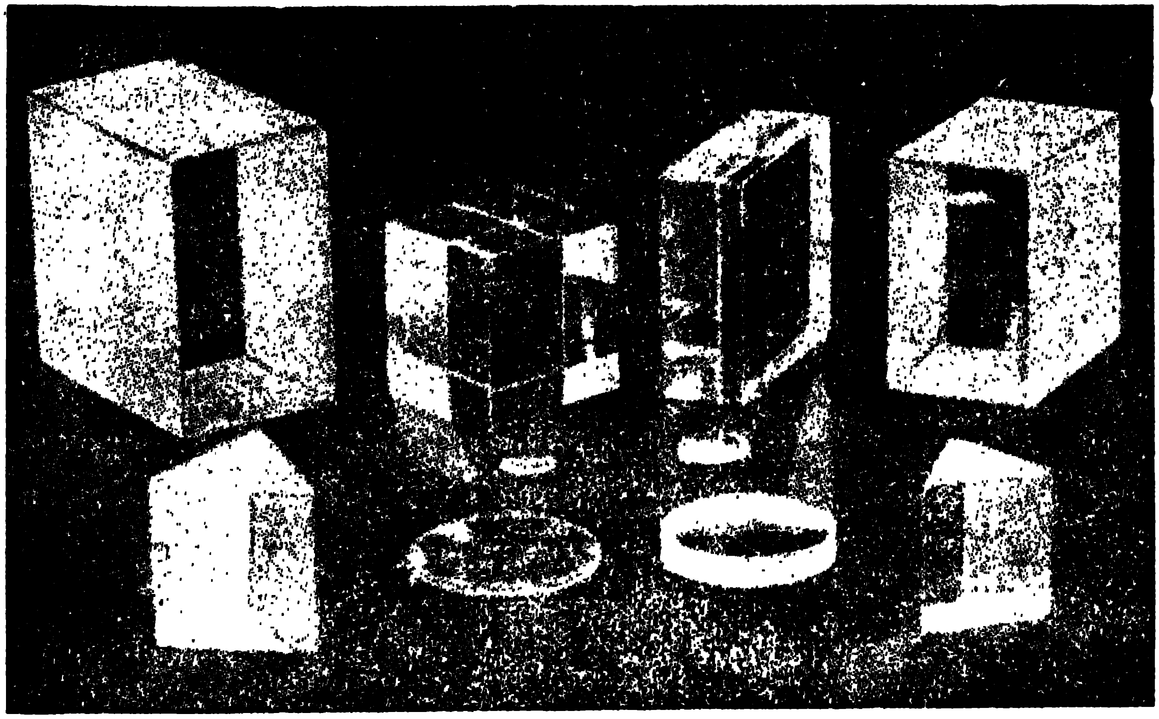

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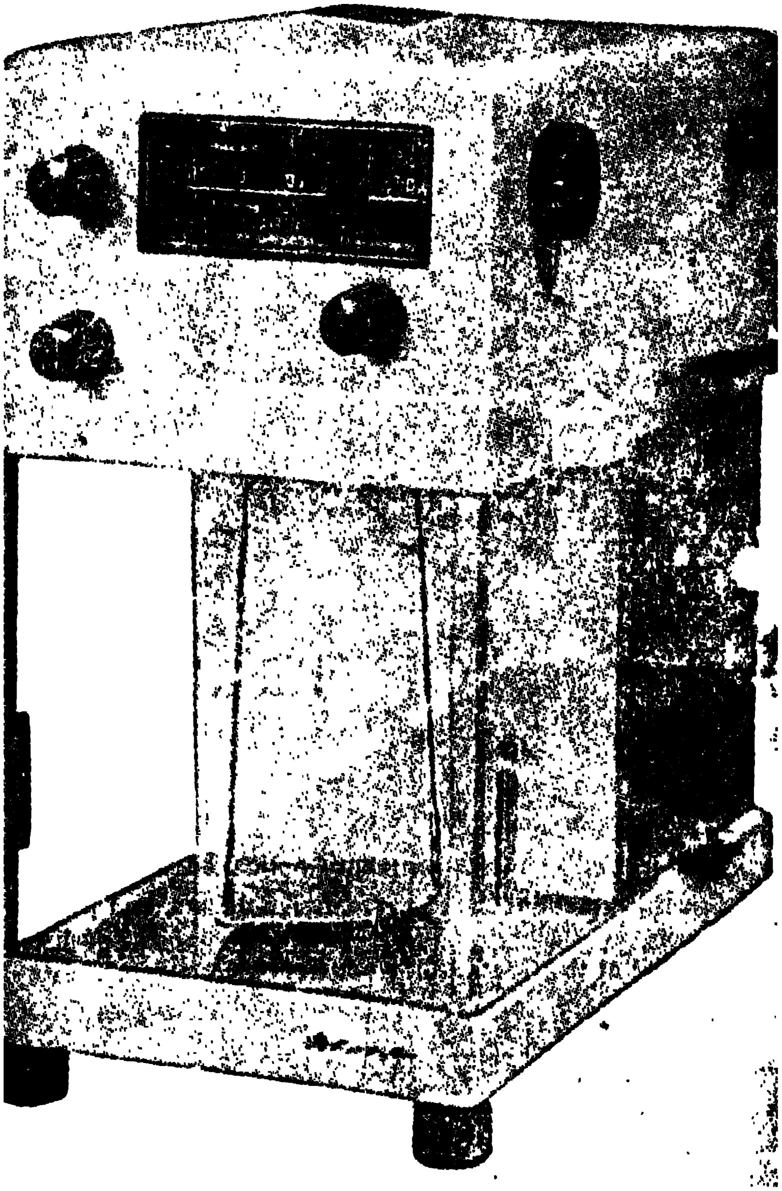

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